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Vigilant and Invincible

- This article, written by former Team Redstone officer Colonel Stephen Moeller, originally appeared in *ADA Magazine*. Colonel Moeller traces the history of the Army Air Defense Command and its role in protecting the continental US during the Cold War. This article has excellent information on NIKE AJAX, NIKE HERCULES, NIKE ZEUS, and ABM weapons and systems.

Vigilant and Invincible

by Colonel Stephen P. Moeller

Preface: Colonel Moeller's article first appeared in the May-June 1995 issue of *ADA* (Air Defense Artillery) *Magazine*. This article does not necessarily reflect the position of the US Army Missile Command, the Army Materiel Command, or the Department of the Army. Certain photographs and drawing contained in the original article have been omitted for the sake of space. Colonel Moeller is presently assigned to the US Army Space and Strategic Defense Command, located in Huntsville, Alabama. This document has been cleared for unlimited public release by Headquarters, Department of the Army.

Introduction

"Vigilant and Invincible" was the motto of the U.S. Army Air Defense Command, or ARADCOM. From the first deployment of World War II-vintage anti-aircraft guns in 1950 to the inactivation of the last NIKE HERCULES missile system in 1974, ARADCOM provided a deterrent to the Soviet strategic bomber threat for the U.S. homeland. During this period, the Army built, operated, improved and then dismantled a vast network of defenses. These defenses protected the nation's capital, key industrial areas, ports, atomic weapon production facilities and Strategic Air Command (SAC) bases from air attack.

World War II generated a tremendous leap in military technology, especially in strategic bombers, air-breathing missiles like the German V-1, ballistic missiles like the German V-2, jet-powered airplanes and atomic bombs. These advances in technology, combined with the Soviet Union's threat of world domination in the post-war years, caused the United States to take action to prevent yet another war this century. And if deterrence failed, the objective was to limit the damage to its citizenry and war-making capability.

During the final months of World War II, several major defense contractors studied the likelihood that evolving technologies could produce guided missiles to intercept bombers and surface-to-surface missiles. One of these projects, called NIKE after the Greek goddess of victory, would grow to a full deployment of more than 240 missile sites in the United States. Operating these sites were nearly 45,000 active duty and National Guard soldiers. ARADCOM controlled these missiles and anti-aircraft guns and a vast network of command centers to communicate with them.

This research will view ARADCOM in the light of various threats, and also of national and military events of the times. Threat-wise, the Soviet Union dominated the scene; its bombers and ballistic missiles held center stage in decisions made to deploy defensive systems. This work highlights the increasing threat of Soviet military power and makes mention of another belligerent communist state, China. The writing approach divides this work into decades, starting with the pre-deployment period of the 1940s. Chapters are devoted to each decade up to the 1970s. The final chapter draws some conclusions from the topics discussed previously.

Nationally, the focus will be on key decisions made in Washington. Administrations from Truman through Ford made tough calls in allocating resources within the nation and the military. Budgets, taxes and competing domestic needs caused decisions on deploying systems to be politically challenging, to say the least.

Within the military, the services interacted to accomplish the air defense mission. Actions by the Department of Defense (DoD), the North American Air Defense Command (NORAD), and the other services, especially the Air Force, will be discussed. This interaction included a competition for resources that developed into inter-service rivalry. Yet the rivals cooperated in many ventures to ensure national defense.

ARADCOM, whose motto was "Vigilant and Invincible", is the primary focus of this work. Given all the external factors of the threat, the nation and the other elements of the military, ARADCOM was the last line of defense against attacking enemy

aircraft. The following chapters describe how ARADCOM went about that endeavor over a period of 24 years. Also included are descriptions of some of the various technologies and equipments used by the command.

When deterrence became a part of the United States' national strategy, ARADCOM was key and essential to that effort. Was it successful? Measured by the number of attacks on the United States by the Soviets in the 24 years of ARADCOM's existence, it was 100 percent so.

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CHAPTER ONE: Pre-deployment - The 1940s

The decade of the 1940s, from the surprise attack on Pearl Harbor in 1941 to the Soviet Union's first atomic detonation in 1949, set the stage for the formation of ARADCOM. Significant refinements to air warfare and, concurrently, to air defense were realized during the Second World War. Then, in the latter half of the decade, the threat posed by the Soviet Union's aggressiveness and its success with nuclear arms produced the Cold War. The United States responded by deploying, over the following decades, a vast air defense network to protect its population centers, industrial base and strategic forces from air attack.

The primary event that led the United States into World War II, the Japanese surprise attack on Pearl Harbor, left an imprint on nearly every American. Many Americans believed the attack resulted from a lack of strategic vigilance, and for decades afterward, they sought to prevent a recurrence. The most immediate reaction to the threat of air attack against the North American continent came in the form of mobilized civilians who, during World War II, volunteered to watch the skies over the United States. One and a half million volunteers of the Ground Observer Corps provided early warning in case enemy aircraft should attack. The Ground Observer Corps, together with newly activated antiaircraft units, fighter squadrons and radar sites, comprised all the major components of the vast air defense network that would be developed in the years to come.

During the war, the overseas battlefield became a part of the larger weapons laboratory. As aircraft technology improved, allowing planes to fly higher and faster, and new strategic weapons of terror and mass destruction fell on England, concomitant improvements were made to antiaircraft weaponry. Significant to the history of ARADCOM was the introduction and improvement of gun directors during the war. These gun directors linked the technologies of rudimentary computers, range finders and radars. These devices enabled antiaircraft batteries to destroy hostile aircraft, even when those who operated the guns could not see their targets. The directors provided a continuous stream of fire control data that was transmitted electronically to the guns. These calculations predicted a likely intercept point, if the target continued on the same course. These combinations of guns, directors and radars (plus the variable time [VT] fuse [see Chapter Two]) were most effective against targets that could not maneuver, such as the German V-1 "Buzz Bomb."

However, when engaged, maneuverable targets would dive, climb, turn, speed up, slow down or perform a combination of moves. Since the shells fired from antiaircraft guns could not maneuver, the logical next step was to find a projectile that could.

Even before the end of the Second World War, major research firms conducted feasibility studies to determine if ground-launched guided missiles could intercept aircraft. Initially they used the same fire control equipment perfected during the war. Another event that would significantly impact on ARADCOM happened during the last months of World War II, when Germany introduced the first ballistic missile, the V-2.

The V-2 was a formidable weapon by any standard. This 46-foot tall, 14-ton behemoth could travel from its launch sites in Nazi-occupied Holland and impact in downtown London in five minutes, reaching speeds of 3,500 miles per hour on the way. Planning on countermeasures to the new ballistic-missile threat started almost immediately. However, ARADCOM would never realize a defense against ballistic missiles, even though it would be heavily involved during the '60s and '70s in the study, development and fielding of America's first and short-lived antiballistic missile system.

The Soviet Threat

In the latter half of the 1940s, as America and the rest of the world began to recover after the war, the portents of yet another war loomed on the horizon. Communism expanded from the Soviet Union westward into Yugoslavia, Albania, Romania, Bulgaria, Poland, Hungary and Czechoslovakia. The Berlin Blockade, which the United States countered with the Berlin Airlift, was another example of Soviet aggression. And in the Far East, the Communist forces under Mao Tse-tung wrestled U.S.-backed nationalist forces under Chiang Kai-shek for China.

The leader of the oldest communist nation, Joseph Stalin, maintained that world peace was impossible under the capitalistic development of world economy. The Soviets adhered to the Marxist view that conflict between capitalism and communism was inevitable.

By the end of World War II, the Soviets had lost millions of people and witnessed the virtual destruction of many of their cities. But they had gained in the ability to wage modern warfare through the acquisition and reproduction of modern weaponry like the Tu-4 "Bull" bomber, a copy of the U.S. B-29; the capture of German scientists, who would help them develop atomic weapons and missiles; and the conduct of scientific and industrial espionage. The impact on the United States would be two fold: first, the Tu-4 gave the Soviets the capability to strike the United States by flying over the North Pole, and second, once they developed the atom bomb, they could visit massive destruction on the United States with just a few sorties, as the United States had done to Japan with its bombings of Hiroshima and Nagasaki.

The Nation

After World War II, most Americans were preoccupied with cashing in on the postwar economic boom. For those whose loved ones had fallen in battle, the sacrifices had been great, but on the whole, the United States had emerged from the war in much better shape than it had entered the war. Riding on the crest of victory, most Americans considered the United States invulnerable and were slow to respond to the ill-defined postwar threat. For several years America had no defense at all from air attack. Not until the threat became better defined would American citizens deviate from their single-minded pursuit of prosperity and affluence.

The following passage from *History of Strategic Air and Ballistic Missile Defense - 1945-1955*, prepared by the Braddock, Dunn and McDonald (BDM) Corporation for the Office, Chief of Military History, Department of Defense, describes America's post-World War II posture:

The postwar national strategy saw the United States abandon its tradition of isolationism for collective security through the United Nations and continued cooperation with its war-time allies in the occupation of the lands of their former enemies. It was generally accepted in 1955 that the key elements of future U.S. strategy would be: (1) support for the United Nations . . . , (2) forward deployment in both the Atlantic and Pacific, (3) relatively strong Air and Naval forces in being, (4) continuation of the U.S. monopoly of atomic weapons..., (5) a small Regular Army and (6) a large well-organized reserve of citizen soldiers.

This strategy fit the mood of the American people at that time and, indeed, it is doubtful if any more militant strategy could have been possible in face of the overwhelming desire to buy the cars and build the houses and raise the families that wartime conditions had precluded. There was a widespread feeling among Americans that all enemies were defeated in World War II, and that the prestige that American military might had accrued in the war would deter any future enemies.

At the national level in the United States, the decision makers were hardheaded realists who recognized that the overwhelming concern of the American people was for their own economic and domestic policies. President Harry Truman placed a budget ceiling on the cost of the U.S. armed forces and adamantly refused to raise it despite repeated requests from his key national security advisors. He did not concern himself overmuch with the way the military services divided up that budget or what they bought with it, as long as they carried out the strategy and remained within the austere budgetary limitations he imposed.

Due to the austere military budgets and reliance on the mobilization system, there was little thinking or planning for any future war except the "big war." Military planners and leaders were oriented toward a major war in Europe. They expected to employ strategic air power with nuclear weapons and project mobilized U.S. military strength overseas to fight another total war. It was not anticipated that the Soviet Union would develop atomic weapons until 1952, so the postwar strategy was believed to be valid for some years. U.S. military forces were not ready for the events that occurred after 1947.

The Military

While the civilian population was content to return to normalcy, military leaders looked at lessons learned from the war as a guide for the future. Two major lessons were that a surprise attack must not be allowed and that air defenses were effective against air attacks.

One of the first orders of business after the war was a detailed and highly publicized investigation of the circumstances surrounding the success of the surprise attack on Pearl Harbor. Among the results of the investigation was the revelation that radar had successfully detected the approach of the Japanese air fleet, but that administrative failure and breakdown had negated the value of that tactical warning. The principal lesson learned was "don't be surprised!" National defense strategists, as a result, worked under the assumption that World War III, like World War II, would start with a surprise attack.

The study of World War II also concluded that, although air attack could seriously damage the war-making infrastructure of a country, as in the case of Japan, an effective air defense could keep a country's capability intact, as demonstrated by Britain and Germany. The British survived massed bomber attacks during the Blitz and, later in the war, weathered Hitler's V-I and V-2 rockets while maintaining and improving their industrial capacity, principally because Germany targeted Britain's population centers rather than its industrial capacity.

British and American strategic bombers devastated the German heartland during the great bomber offensives that served as a prelude to the Allied invasion of the continent, but at a very high cost to Allied aircrews. The German air defense of the homeland contained some basic flaws, but by the end of 1944, was the most formidable the world had ever seen. The German mix of antiaircraft guns, interceptors and night fighters inflicted casualties that approached unacceptable levels.

Surprisingly, postwar surveys revealed that Germany actually increased production during 1944 and 1945, while its industrial centers were under the massed attacks of the greatest bomber forces ever assembled. The German air defense example left the U.S. air defenders with the belief that it was possible to organize an air defense system that could protect the industrial base and inflict unacceptable losses on an attacking strategic force.

The strategic air attack on Japan presented the "worst case" example of just what can happen to a civilian population and an

industrial base when an effective air defense is absent. Japan spent its air power far from the home islands. When U.S. B-29s arrived in strength over the home islands, they were virtually unopposed in the air. In fact, the leader of B-29 forces stated that the air over Japan was safer than that over training bases in the United States. The air defenders in the U. S. military forces took the lesson of Japan to heart.

World War II, then, encouraged a belief in a global war started by surprise attack and strongly implanted a relatively new belief in the necessity of providing effective defenses for the industrial base in the continental United States.

Those entrusted with national defense struggled with many difficult decisions, not the least of which was the role each service would play in peacetime. The Army Ground Forces and the Army Air Forces battled over the ownership of antiaircraft artillery (AAA). The Army Air Force argued that since it was responsible for controlling the skies, any weapons used in aerial warfare should belong to it, especially for command and control reasons to prevent fratricide. The Ground Forces countered that antiaircraft provided defense of ground targets from air strike and would therefore be employed more effectively by those it was to protect. Antiaircraft guns also had the additional capability of being used as field artillery to support the ground forces. The Ground Forces had spent more of its resources developing antiaircraft weaponry; moreover, antiaircraft units were linked by lineage and tradition to the old Coast Artillery branch, resulting in well-established ties and loyalties to the Army's ground forces. Even after the Secretary of Defense and the Joint Chiefs of Staff (JCS) rejected the then newly-formed Air Force's demand for AAA at the Key West Conference in March 1948, the debate lingered and continued into the 1950s. It finally devolved into a control issue once it was clear that the Army would retain AAA forces.

The military establishment worried about the growing Soviet threat in the last half of the 1940s. The intercontinental capability of the Bull bomber had a minor impact on U.S. air defense strategy compared to the announcement in August 1949 that the Soviets had detonated their first atomic bomb, three to four years ahead of the schedule anticipated by U.S. defense planners. The Bull and the bomb meant the Soviets now possessed the capability of causing mass destruction within the United States.

In the years preceding this detonation, the national leadership had taken some *pro forma* measures to defend against air attack. In 1946, the Air Force formed the Air Defense Command. Although it was initially overshadowed by the Strategic Air Command (SAC) and the Tactical Air Command (TAC), it grew in importance in proportion to the Soviet threat. However, it did suffer at the hands of those SAC proponents who argued that the best defense was a potent offense.

In mid-1948, an economic recession caused a budget deficit of \$2 billion. As the congressional purse strings tightened, the Air Force concentrated on building up SAC at the expense of the other missions. To make the best use of all air resources in the continental United States (CONUS), rather than divide them among several commands, the Continental Air Command (ConAC) was established. ConAC received command of the six air forces formerly assigned to Air Defense Command and TAC, the Air National Guard and the Air Reserve. The Air National Guard's participation included 55 fighter squadrons flying P-51 Mustangs and P-47 Thunderbolts and nine light bomber groups flying A-26 Invaders. ConAC also actively pursued the establishment of an early warning system.

Army Air Defense

The Army's portion of continental air defense in the late '40s consisted mostly of National Guard units. In 1948, the National Guard was called upon to furnish 123 antiaircraft battalions to be ready by 1952. The greatly expanded National Guard AAA force, when fully organized, would have 809 separate units with 77,822 men deployed throughout 27 states, Puerto Rico and the District of Columbia.

By 1948, four states (Alabama, Maine, Rhode Island and Texas) and the District of Columbia had organized all the antiaircraft units allotted them. Throughout the country, there were a total of 534 federally recognized antiaircraft units, or 66 percent of the 809 units in the entire troop base. They had an aggregate strength of more than 21,000 men, or 27 percent of their ultimate projected strength.

Project NIKE

Fortunately, back in 1945, the Army's Ordnance Corps had asked Bell Telephone Laboratories to study the likelihood of developing an antiaircraft system incorporating guided missiles. Since Bell Labs had produced the gun directors and radars that were so successful during the war, they naturally capitalized on that knowledge for Project NIKE.

On May 14, 1945, representatives of the Bell Telephone Labs gave a verbal report on the results of their study of a new AAA system that "envisioned development of a 1,000-pound guided missile, 19 feet long and 16 inches in diameter, with an effective range of 20,000 yards and an effective altitude of 60,000 feet. It was to be powered with an acid-aniline, liquid fuel rocket motor and was to attain a maximum velocity of 23,000 feet per second at the end of burning. The control system was to contain two radars - one tracking the target and the other tracking the air defense missile - and a computer for comparing the data from the radars." Amazingly, given the new technologies that would have to emerge, the NIKE AJAX system fielded just eight years later closely resembled this initial study.

Bell Lab's *History of Engineering and Science* explained their engineering approach to this project:

...development should not await the results of research projects that were still in a stage of uncertain success, such as those on ramjet engines, radically new fuels, and drastically new guidance or homing techniques. Another axiom of the system design philosophy was that the expendable projectile should be as simple and inexpensive as possible, leaving the more complex and more expensive equipment on the ground.

Thus, the development of the many new or improved technologies required in rocketry, guidance and control would not use the building-block approach, perfecting one stage before going on to another. Rather, developers would work along parallel tracks, betting on each research field to come up with solutions to problems prior to integration of the entire system. This approach paid off in 1950 when the nation called upon the Army to protect vital areas in the United States from air attack. The Army needed only three years to deploy a NIKE missile system.

Summary

A passage from *History of Strategic Air and Ballistic Missile Defense -1945-1955*, prepared by the BMD Corporation for the Office, Chief of Military History, Department of Defense, summarizes the events of this decade:

The period from the end of World War II until the outbreak of the Korean War saw the development of the Cold War with Russia, which split the world into two hostile groups. The United States concentrated on the development of its economy and its monopoly of the atomic weapon at the expense of conventional military strength. However, even with the scare effect of the Russian atomic bomb, it is doubtful if the American public would have supported the increased taxes and spending that such an increase would demand. That public reluctance was significantly reduced after the Communists committed open aggression against South Korea. The Korean War provided the event that U.S. national leaders needed to raise U.S. armaments to the level that the world situation required.

The children of the Baby Boom were not, as their fathers who defeated Germany and Japan had imagined, destined to grow up in a non-threatening world. At home, their parents built backyard bomb shelters they would later convert into fallout shelters. During air raid drills, schoolchildren left their classrooms to huddle in darkened hallways. Announcements that "This station is about to conduct a test of the National Early Warning Broadcast System" interrupted the innocent melodies of the "Hit Parade." The Cold War had arrived, bringing with it the threat of undreamed horrors. It was to last nearly half a century, and for the greater part of the struggle, antiaircraft artillery men were to serve as front-line soldiers.

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CHAPTER TWO: Activation and Deployment - The 1950s

The Army formed its Army Antiaircraft Command (ARAACOM) in July 1950, with a mere handful of people stationed at the Pentagon. During the decade, the new command would experience unprecedented growth, employ at its height nearly 45,000 soldiers with more than 240 missile batteries throughout the nation, and advance from antiaircraft guns to two versions of the NIKE guided missile system. Moreover, the Army air defenses were only a part of the overall military juggernaut that started rolling in the 50s. A vast air defense network that included supersonic jet fighters, antiaircraft guns and missiles, radars of all varieties, hundreds of information-passing nodes, and tens of thousands of soldiers, airmen, sailors and civilians was first established to counter the anticipated Soviet bomber threat. When the Soviets realized they could not achieve superiority or even parity with America's offensive might represented by the SAC bomber forces, they strategically outmaneuvered the United States by choosing, instead, to compete on the ballistic missile playing field.

The 1950s saw the United States become increasingly reactive to a growing Soviet threat, whether perceived or real. With the Korean War, the bomber gap, Sputnik and Soviet development of fusion bombs and ballistic missiles providing a sense of urgency, America's air defenses grew from just notions into a prodigious, integrated air defense system. U.S. military and civilian leaders first responded to the Soviet threat by laying out a strategic vision in a document known as National Security Council (NSC) 68, then revised and refined that vision over the years, maintaining a decided edge in the nuclear arms race.

The U.S. military continued its competition for resources on the national level and among the different services. As in the '40s, the battle lines were drawn between the need for offensive and defensive forces.

The challenge for ARAACOM, which was later to become ARADCOM, was to protect vital areas of the nation from direct attack by air. That mission was broken into integral components: land acquisition and deployment around major metropolitan areas; training tens of thousands of soldiers in the latest, most advanced technology; and maintaining a wartime vigilance in a peacetime setting.

The Soviet Threat

By 1950 it was clear that the Soviet Union was in the Cold War to win. It gained increasing influence throughout the world, in many instances by the rule of force. The North Korean invasion of South Korea in June 1950 was yet another example of the global expansion of communism. Many saw Korea as a prelude to another world war, a Soviet diversion that would be followed by their main effort, to take place in Europe. Soon after the Korean War, tensions eased a bit upon the death of Stalin in 1953, when the less bellicose Georgi Malenkov rose to power. Although Malenkov believed that production of weapons of mass destruction should be kept to a minimum, other influential Soviet politicians seized upon the absence of Stalin, who had downplayed the value of strategic surprise, to strongly advocate the development of strategic strike forces. When Nikita Khrushchev seized power in 1958, the stage was set for the Soviets to enter the arms race at full force.

The Bomber Gap

The first attention-getter occurred on Soviet Aviation Day in July 1955, when 10 Bison jet-powered strategic bombers flew past the reviewing stand. These same aircraft flew past six times, creating the illusion that the Soviets possessed 60 aircraft. This show, combined with the introduction of the smaller Badger jet-powered bomber the year before, resulted in a deception known as the "bomber gap." The Soviet tendency to unveil new weapons during public events, often to the surprise of Western observers, added to their shock value. Western analysts extrapolated from the illusionary 60 aircraft, judging that it would take only a short time for the Soviets to produce 600. Even with 600 planes, the Soviets could not match the United States plane for plane, but the mere perception that the Soviets had many planes that could reach over the northern polar cap to America was enough to reinforce the American arms buildup that was already underway.

Shortly thereafter, the Soviets introduced another strategic bomber, the Bear. Soviet Long-Range Aviation (LRA) squadrons began receiving Bear bombers in 1956 and 1957, and by the end of the decade, some 150 Bears and well over 1,000 Badgers were in service. Total production was approximately 300 Bears and 1,500 to 2,000 Badgers. The combined payload of the LRA Bear and Badger force probably totaled no more than 10,000 megatons.

The Missile Gap

In 1957, the Soviets achieved a significant technological and psychological breakthrough when they launched the world's first artificial satellite into space. Called the Sputnik, this satellite shocked the American public into believing their country was scientifically second-rate. A month after the Sputnik launch, the Soviets put a dog in orbit, and the following year, a 3,000-pound payload, a feat the United States would not match until 1964. Khrushchev quickly exploited these Soviet successes by emphasizing that the era of the strategic bomber was past, that intercontinental ballistic missiles were cheaper to maintain and that that was where the Soviets would place their emphasis.

The Nation

In the United States, the '50s started with a policy statement that, for the first time in U.S. history, defined communism as a threat to its form of government and recommended a national strategy to deal with that threat. Called NSC 68, this document

was a landmark in both content and timing. It contained a proposed outline for American defense of the free world and was printed just several months prior to the surprise invasion of South Korea by the communist North.

Upon the change of administrations in 1953, when Eisenhower succeeded Truman, a follow-on to NSC 68, appropriately called "New Look," recommended that the United States strike a balance of forces. The Soviets were numerically stronger in conventional forces, while the United States held a decisive advantage in nuclear weapons and the ability to deliver them by B47 bombers stationed within striking distance of the Soviet Union. The New Look recommended building U.S. conventional forces to offset the eventual increase in Soviet nuclear forces. But the New Look was overruled by NSC 162, which did not see the need for more U.S. conventional forces. Secretary of State John Foster Dulles preferred massive retaliation to prevent war, even though the Korean War had proved that the threat of massive retaliation did not prevent warfare. Just three years later, this strategic vision was once again revisited. The result was the "New" New Look. Because of the Soviets' success in developing the H-bomb (as the United States had some years earlier) and their unveiling of several new intercontinental bombers, a "balance of terror" existed between both sides. A global war would be disastrous to all participants.

The Military

The 1950s dawned with the U.S. military fighting two wars at once: a hot one in Korea and a cold one with the Soviet Union. The military saw both as real threats and allocated its finite resources accordingly. Within the military, other wars were being fought over resources. For example, an internal Air Force squabble between offensive and defensive forces reached new heights. SAC forcefully argued that the best defense was a good offense, while the Air Defense Command countered that the enemy could bomb anywhere in the United States at any time.

Since the Air Force was responsible for the overall defense of the United States from air attack, the Air Defense Command looked to the other services to contribute as well. The Navy was to assist in the early warning network and the research and development of new missiles and radars. The Army would play a major role in providing guns and surface-to-air missiles, and its units would eventually outnumber their Air Force counterpart in numbers of fighting battalions compared to interceptor squadrons. The Key West Conference of 1948 left a lot of room for interpretation, and not until the chiefs of staff of the Army and the Air Force agreed in 1950 did actual duties and responsibilities of both services jell. Yet even finer details of inter-service cooperation would be worked on in the '50s, especially after a poor showing of Army gun units during joint exercises early in the decade. Many "hostile" aircraft were not engaged because of over-restrictive rules of engagement. Other interservice competitions between the Army and Air Force were fought in the missile and electronic arenas. Surface-to-surface missiles, early warning and surveillance radars were involved in the dispute, especially since each service had its own independent research and development effort. Each service would emerge as victor and loser: the Air Force won the intercontinental surface-to-surface and early warning radar fights, but lost the shorter range missiles and surveillance radar to the Army. The Army won the surface-to-air missile fight, but the Air Force insisted on and finally deployed several squadrons of its own missile, the BOMARC. The missile's name came from "BO" for Boeing and "MARC" for Michigan Air Research Center. The air defense concept called for a missile with a speed of Mach 2.5 and a range exceeding 400 miles that would strike an enemy bomber as far from its target as possible. The improved BOMARC B could be equipped with a nuclear warhead and synchronized with the semiautomatic ground environment (SAGE) network.

The Early Warning Network

Other major elements of this integrated air defense network were direct results of the lessons learned from Pearl Harbor. The United States was concerned about the effectiveness of early warning and the ability to react in a timely manner. Much study and investment was therefore devoted to this problem. Early detection of enemy aircraft was difficult due to the size of the United States, the lack of enough radars, and the short range of radars in those early years. The Ground Observer Corps was called upon to fill the gaps and supplement the radar early warning coverage. Once enemy penetrators were detected, Ground Observer Corps observers would pass information to control centers responsible for alerting fighter interceptors and the antiaircraft crews. Along with the Ground Observer Corps was a medium-range radar network known as LASHUP. It consisted of 44 World War II-vintage radars located near major metropolitan areas of the country. In the early 1950s, other early warning radar networks were on the drawing boards. The first to be activated was the Pine Tree Line in 1954. It consisted of a series of more than 30 radars located roughly along the U.S.-Canadian border and dedicated solely to early warning. In 1957, the Distant Early Warning (DEW) Line, a series of 58 radars, became operational along the arctic circle from Greenland to Alaska. The final land-based line of radars, known as the Mid-Canada Line, was activated in 1958. This line extended from Newfoundland across Canada along approximately the 54th parallel, and then ran north along the Alaska highway before connecting with the Alaska radar system.

These three series of radar lines were oriented to detect an attack across the polar cap, the most direct route from the Soviet Union. To supplement defense of the flanks of the continent, the Navy provided radar picket ships and flew early warning airplanes and blimps, while the Air Force flew sentry aircraft and also emplaced four radar towers, called Texas Towers, out in the Atlantic.

ARAACOM, with its 157 radars (AN/TPS-1s) located throughout the United States, also contributed during this era to the early warning network. These radars were sited and used from whatever advantageous terrain the Army could obtain, often many miles from the defended area. These sites were on property owned by federal, state or city governments, or on private land that was borrowed, rented or leased.

When the Army lost the early warning radar battle to the Air Force, it was forced to give up its advantageous terrain locations and 10 to 15 minutes of track data time. The Army pulled its radars back into or near the vicinity of the defended area.

To tie this multi-layered early warning capability to its own fighter squadrons and the Army's Air Defense Command, the Air Force, in 1958, deployed a command and control apparatus called the SAGE. SAGE was the outgrowth of the manual Ground Control Intercept (GCI) systems used during World War II, which directed intercepting aircraft to enemy penetrators. SAGE embodied the latest innovations in computer technology. It linked many parts of the early warning network and the interceptor network together, transferring data automatically rather than requiring voice commands. The Air Force even had SAGE remotely fire its pilot-less interceptor, the BOMARC.

One serious flaw in automated command and control was that newly developed systems were not compatible with other systems. The Air Force's SAGE system could not pass data digitally to the Army's Missile Master system because each processed data at different rates. Further engineering was necessary to produce a digital data converter.

Continental air defense planners envisioned that the air battle over the United States would be fought by both Air

Force and Army elements. The first step was early warning. Ground-, sea- and air-based radars would see blips on their radar screens, warning them of attack. These sentries would radio or telephone this information to control centers, which in turn would relay the warning down to interceptor squadrons and antiaircraft defenses. The fighter interceptors would engage the penetrators as far from their intended targets as possible. Those enemy bombers that got through would be engaged by antiaircraft batteries that were deployed around likely, high-value targets.

War in Korea

The Korean War provided the impetus that got the air defense program rolling on many levels and in many areas. The fielding of AAA forces, interceptor squadrons and supporting elements shifted into high gear. The Communist menace that gripped a large part of the Northern Hemisphere now confronted the United States in North Korea. It was no secret that the North Koreans were being supplied by the Soviets and the communist Chinese.

When the Chinese entered the war, direct confrontation between superpowers ensued. America now girded itself for a possible attack on its homeland.

Just a few days after the North Korean invasion of the South, the United States air defenses, consisting mostly of fighter interceptors, commenced around-the-clock operations. ARAACOM was formed within a week. National Guard forces, organized in the late '40s, were called upon to fill in for active Air Force and Army units that deployed both to Korea and to Germany.

Shortly after the outbreak of the war, the Air Defense Identification Zone (ADIZ) was established. President Truman authorized the engagement of unidentified aircraft not positively identified as friendly. Airlines and private pilots began to file flight plans with a sense of purpose.

In summary, the U.S. military grew during this decade due to a national strategy for the Cold War and the realities of the hot war in Korea. The Army, Air Force and Navy eventually cooperated in the air defense of the continent and built a massive system to detect, identify, attack and destroy the Soviet strategic bomber forces.

ARAACOM and ARADCOM

Even before ARAACOM was born in 1950, batteries of 120mm guns had deployed to protect the plutonium production plant at Hanford, Washington. In March, the first battery of the 518th AAA Battalion arrived in Hanford, and by May, the entire unit was in place. That same month, an ad hoc interservice committee recommended that 60 critical areas be defended by antiaircraft artillery. The list was cut to 23, and plans called for them to be defended by 66 AAA battalions. Concurrently, a Department of the Army (DA) study concluded that a separate AAA command structure was necessary to control this deployment (at the time, each of the six armies based in the continental United States controlled its organic AAA assets).

Several months later North Korea invaded South Korea. The Army acted quickly to adopt an AAA command and control structure as envisioned by the Army staff study. In July, Maj. Gen. Willard W. Irvine, who at the time was the Army's liaison to ConAC, assumed command of ARAACOM. The Secretary of the Army gave him the mission to continue to support the commanding general, ConAC, and when directed by the JCS or if the United States was attacked, to assume command of the AAA units allocated to air defense of the continental United States.

Irvine and his small staff initially rendered support of ConAC from the Pentagon. Not until November did they move to be near their supported agency at Mitchel Air Force Base, NY. They were collocated there for only a few months, then moved in January 1951 to their final home in Colorado Springs, Cob. Although the ARAACOM staff numbered approximately 20

bodies, there was not enough room for them at Ent Air Force Base, the new home of the Air Defense Command. The ARAACOM staff moved into the basement of the Antlers Hotel, where they remained for several years before moving to Ent.

Before the initial move from the Pentagon to New York, two significant actions had taken place. The first one, in August 1950, saw the Army and Air Force finally agree on how AAA forces would be controlled when defending the United States. Both of the services' chiefs of staff signed an agreement that outlined each service's responsibilities. The Collins-Vandenberg Agreement provided for joint decision-making at departmental level on targets to be defended by AAA, mutual Army-Air Force agreement on the location of defenses (except that tactical dispositions were to be determined by AAA commanders), and Army staff representation at each echelon of the U.S. Air Force command structure charged with air defense. The agreement assigned operational control of AAA to U.S. Air Force air defense division commanders "insofar as engagement and disengagement of fire is concerned."

Irvine formed two major subordinate headquarters to be collocated with the Air Force's air divisions at Stewart Air Force Base, NY, and Hamilton Air Force Base, California. Called the Eastern and Western Army Antiaircraft Commands, they started off smaller than their parent organization, initially having only two persons assigned.

Mission

ARADCOM's mission was to train and deploy antiaircraft forces in defense of critical areas of the country. The listing of critical areas would be massaged and changed over the years, but the initial list included industrial centers, the national capital region, SAC bases, Atomic Energy Commission sites, and other key areas such as the narrows and locks at Sault Sainte Marie, naval bases at Norfolk and Philadelphia, and the electric power production facilities at Niagara Falls.

There were many more assets to be defended than there were forces to defend them. Even after the initial listing of 60

areas to defend was scrubbed to 23, the Army of 1950 had only 15 usable AAA battalions on active duty. The Army would expand that number to 45 battalions by the end of 1951, due in large part to the addition of National Guard battalions federalized for the Korean War. Although these antiaircraft battalions were available, the vast majority were not deployed around the assets they were to defend. Some units had to travel hundreds of miles to the assets they were to protect. Not until land could be acquired, facilities built and troops deployed would these critical assets be protected from a surprise attack.

Several sites enjoyed this type of permanent protection in 1951, notably the Hanford Atomic Energy plant in Washington and the Sault Sainte Marie locks in Michigan. In 1952, dozens of 90mm and 120mm gun batteries, and several automatic weapons (AW) batteries, deployed in protection of Washington, Baltimore, Norfolk, Chicago, Detroit, New York, Philadelphia, Pittsburgh, Boston, Niagara Falls, San Francisco, Limestone Air Force Base in Maine, and Fairchild, Travis, Castle and March Air Force Bases in California. In the rush to deploy these units in 1952, soldiers moved into some areas with few or no facilities. Some units spent that winter in tents.

Gun units typically occupied sites with the only advance planning being a reconnaissance. Then a massive self-help effort was required to overcome the lack of essentials. For example, Battery D of the 18th AAA Battalion occupied a field only 10 miles from the center of Detroit. The field lacked drainage, so after a good rain, the vehicles of this 90mm gun battery sank to their axles. There was no road from the site to the highway. Soldiers slogged around in the mud. Field latrines were set in, along with many tents for sleeping, eating and unit administration. Showers were only available at the local YMCA or school gymnasiums. One hundred soldiers lived permanently in the field just outside Detroit, working in a quagmire. This was a typical site deployment in the early 1950s.

Little if any sympathy was forthcoming from World War II leaders still on active duty. Gen. Maxwell Taylor remarked that it was about time the Coast Artillery got a taste of the field life. Soldiers took on the non-mission related tasks of site improvements, if for no other reason than to defeat boredom and to improve morale. They dug drainage ditches to dry out the sites. They built gravel roads for vehicles and gravel hardstands to keep their guns out of the mud. They scrounged materials to build wooden floors for their tents and erect buildings for sleeping, dining and administration. They built semi-permanent buildings, called "James Ways," when the local labor unions didn't object. Some units, loaded with pride of their own handiwork, put whitewashed picket fences around the sites to beautify them.

Guns and Gun Directors

ARAACOM soldiers operated a mixture of old and new gun systems. The old part was the century-old rifled cannon technology that hurled projectiles at the enemy, and the new was a radar-controlled, computerized, integrated fire control system that pointed the guns.

ARAACOM had three types of AAA battalions: 90mm, 120mm and AW. The most numerous were the very accurate, high-velocity 90s. With an altitude capability of 30,000 feet and a range of 14 miles, the 90mm gun was a proven performer that had scored numerous kills during the Second World War, especially when it was linked to a fire control computer and fitted with VT proximity fuses. One 90mm gun could put 20 to 25 rounds in the air every minute, so a complete battery of four guns firing at an aircraft could put a lot of steel on target.

The M-9 and M-10 gun director systems, produced during World War II, were initially fielded with most ARAACOM units, until the more modern M-33 system could be mass produced. The M-9 and M-10 consisted of an analog computer and a two-seat directing apparatus, called the tracker head, in which two soldiers sat and tracked the target. Information on azimuth, elevation and range of the target was automatically sent to the computer by the tracker head and the SCR-584 tracking radar. The computer then calculated the vertical angle and horizontal direction the guns should point to hit the target. It also calculated the fuse setting for the shell to burst near the target, when using other than VT fuses. This information was transferred electronically to the guns, which fired as quickly as they could be loaded. During World War II, this system was so successful that in August 1944, AAA gunners shot down 89 of 91 German V-I missiles.

The next generation of gun directors was the M-33. Rather than just two tracker operators plus the SCR-584 crew, the M-33 crew consisted of five soldiers who worked in a trailer. Within their trailer, they received a video display from one of their two radars, the acquisition radar. This radar gave them the general locations of aircraft that flew within approximately 75 miles of their site. They were also linked by telephone to their battalion antiaircraft operations center (AAOC), which provided them warning of attack. Once warned, the tactical control officer, a member of the five-man crew, assigned the target to a radar operator who aimed the second radar, a tracking radar, at the target. When he found the target, he had the radar "lock on" to it electronically, and the radar began tracking the target automatically, sending range, bearing and deviation data to the computer. Once the target was in range and determined to be hostile, the four guns of the battery began firing on it.

Another technological advancement made during World War II that enhanced the killing power of AAA batteries was the VT proximity fuse. It caused the shell to detonate, not at a prescribed time from firing like conventional fuses that needed a clock device, but when it neared an object such as an airplane or a missile. The secret program used a small radio and receiver, powered by a battery in the fuse. When the radio's signals bounced off an airplane or missile, its receivers triggered a detonation. This was an astounding development at the time and a great leap in technology. This technology tremendously increased the target hit ratio of AAA gun batteries.

These devices enhanced the capabilities of both the 90mm gun and the longer range 120mm gun. Both weapons were deployed in massive numbers throughout the United States in the 1950s. Several AW battalions of various weapons and calibers were deployed as well.

Peak deployment of the 90mm gun occurred in 1953, when 42 battalions were on line. With each battalion having four batteries, and each battery having four guns, the result was 672 guns pointing skyward to protect the United States. The gun crew consisted of eight or nine men and included a section chief, loader, gunner, azimuth pointer, elevation pointer and a three- or four-man ammo section. The crew both operated and maintained the weapon, which could fire its 24-pound projectile 30,000 feet into the air.

The year 1953 was also the peak year for the number of 120mm battalions. Fourteen were deployed, for a total of 224 guns. The 120mm gun was a trailer-type, mobile weapon weighing about 31 tons with a 13-man crew. Its maximum vertical range was about 58,000 feet. Under good conditions a 120mm gun could deliver 20 seconds of effective fire on a conventional airplane flying at an altitude of 40,000 feet. The rate of fire was from 10 to 15 rounds per minute, depending on three principal factors: state of training of the gun crews, whether or not mechanical time fuzes were being used and the magnitude of the fuze being set. The projectile weighed 50 pounds.

ARAACOM AW battalions defended linear targets, like locks and airfields, from air attack. A new weapon system was developed and fielded in the early 1950s to replace their 40mm guns and .50-caliber machine guns. Called the Skysweeper, it was the first weapon to emerge in the atomic age with radar, computer and gun on one carriage, a fully integrated gun and fire-control system. With its 75mm gun, the Skysweeper could find and track approaching aircraft as far away as 15 miles and destroy air targets as far away as four miles. Its automatic loading and firing capability allowed it to fire 45 rounds a minute. Peak deployment for Skysweeper battalions was achieved in the mid-1950s when eight battalions were deployed.

As more and more NIKE missile systems were deployed, ARAACOM slashed the number of AAA guns in the command in the last half of 1957. By the end of the year only three 75mm Skysweeper battalions remained, one at Sault Sainte Marie and two at Savannah River, plus one 90mm and two Skysweeper battalions at Thule, Greenland.

Description of the Command

In April 1951, ARAACOM was transformed from a planning headquarters to an active command with combat units. A total of 42 units were initially assigned. Of these, 12 were National Guard units federalized for the Korean War. Of all these units, only a few were in firing positions: several gun battalions at Hanford and an AW battalion protecting the locks at Sault Sainte Marie. The remainder of the units were at Army posts at varying distances from the installations they were to defend.

Of the 66 battalions required, only 23 were available, and 12 of those would likely be inactivated once the Korean War ended. So ARAACOM's task was twofold: first, provide sufficient battalions to replace the National Guard, and second, arrange units geographically so that they could best be utilized for defense.

To solve the sufficiency problem, DA was busily activating battalions and associated headquarters to control them. In the 18 months following ARAACOM's assumption of command of all required AAA forces, 42 additional battalions of various types were activated.

Even with all of these battalions, locating them away from the areas they were to defend rendered them useless in the event of a surprise attack. Irvine pleaded his case to the Army staff and argued that the Army component of continental air defense must be a force in being, operationally ready to engage the initial --and likely the most critical-- attack. He wanted all of his units to be in position to engage the enemy, around and near the assets they were to defend so the guns, and later the missiles, could fire without further movement.

As of April 1951, the plan had some units in Michigan set to defend critical assets in California, so many adjustments and movements were necessary to meet Irvine's recommendations, including building permanent sites for gun positions. In June 1951, the ARAACOM staff estimated Irvine's plan would cost \$71.4 million. Since only roughly a third of that amount was available, an interim solution was reached. The "six-hour program" and the 25-percent on-site rotation plan were the initial steps that transformed ARAACOM from a nominal force to a force actually capable of carrying out its mission. The six-hour program required each unit to be located within six hours of its tactical site. The 25-percent on-site rotation plan called for one battery of the four in each battalion to occupy its battle position around the clock.

Irvine's goal was a near-reality by September 1952, when 200 of ARAACOM's 220 batteries were stationed at their firing positions. Land acquisition and site construction became a part of doing business in ARAACOM. Many communities that had not experienced a permanent military presence got their opportunity with ARAACOM, and many more would follow with the deployment of NIKE missiles. ARAACOM's major subgroupings in 1950 were the East and West Army AA Commands. In 1951 the Central Army AA Command was established with headquarters in Kansas City, Mo. However, the preponderance of forces were split between East and West. East ARAACOM had 10 major area defenses. JCS directed protection of two of them, the Washington, DC, defense and the Sault Sainte Marie defense. ARAACOM deployed six battalions of guns on a radius of 8,000 yards centered on the Washington Monument. Their planning was based on the assumption that enemy bombers would attack from 30,000 feet at a speed of 300 knots with either conventional or nuclear bombs. Sault Sainte Marie was considered a linear rather than an area target and, therefore, likely to be attacked with low-level bombing and strafing runs, so an AW battalion consisting of 40mm and quad-50 calibers was deployed along the south side of the locks. This sole battalion was to be supplemented with National Guard and Canadian battalions in the event of a national emergency.

Like East ARAACOM, the West was commanded by a one-star general. Although he was tasked with eight area defenses, the JCS had great concern for the protection of the plutonium production plant at Hanford. Four 120mm battalions were permanently deployed, and they were to be supplemented by two 90mm battalions from the National Guard in case of a national emergency.

ARAACOM was no exception to the rule that problems occur when organizations expand. Irvine's 1951 command report listed six major problems. There was a serious shortage of certain items of equipment and a critical shortage of certain specialists, especially radar repairmen. There were few firing ranges and insufficient funds to put units on permanent sites. No tactical communications linked ARAACOM headquarters through field commands to defended areas, and finally, operational procedures were lacking within ARAACOM and between ARAACOM and the Air Defense Command.

While many of these problems could be solved within the Army, perhaps the thorniest issue, and the one that would take the longest to solve, was the last. Now that gun battalions were being deployed in defensive positions, the Air Force feared that, during an actual air battle or an inadvertent civilian flight over these defended areas, engagement would result in loss of friendly air-craft and pilots, especially passengers in the case of an airliner gone astray. A series of agreements between the two services resulted in rules of engagement, alert statuses and conditions of readiness; however, the issue of releasing units to fire at hostile aircraft was never adequately addressed. Consequently, in July 1952, during an integrated air defense exercise called SIGNPOST, ARAACOM successfully engaged only five of 25 air strikes at areas they were to defend. Commanders held their fire due to a "guns tight" condition imposed by their local Air Force air defense division commander. This meant AAA units could fire only at aircraft positively identified as hostile or observed committing a hostile act. With aircraft flying at altitudes of 30,000 feet, visual identification could not be made, and electronic identification was not effectively used, so identification was out of the question. By the time the enemy penetrators had committed a hostile act, in this case dropping imaginary bombs, AAA was not likely to engage. In the event of a real attack, most AAA would turn into weapons of revenge, if they survived the bombing, since the enemy would have already accomplished their mission. This problem was never solved to the satisfaction of Army air defenders.

Following the cessation of major hostilities in Korea in 1953, National Guard battalions that had been federalized for the war were quickly inactivated. Regular Army battalions replaced them. But the role of the National Guard in the scheme of ARAACOM was far from over. The Army chief of staff eventually saw the Guard as a source of economy, both in dollars and manpower, if they were used to man defenses. Rather than federalize every member of these AAA outfits, a certain core of technicians and leaders were selected and designated Special Security Forces (SSF). Each firing battery had 15 such SSF personnel who worked full time. The additional personnel required to round out the battery were ordinary guardsmen who drilled one weekend a month and attended a two-week camp once a year, a period AAA units usually spent on a firing range.

Generally the National Guard followed behind the Regular Army units. When a Regular Army battalion turned in guns for

missiles, the Guard assumed responsibility for the guns. Similarly, when the Regular Army battalions progressed from NIKE AJAX to NIKE HERCULES, the National Guard took over NIKE AJAX until it was removed from the inventory. Finally, in the 1960s, the National Guard manned the premier systems of the time when only NIKE HERCULES units were left in the inventory.

The Ever-Changing Command Structure

Although the command's motto was "Vigilant and Invincible," its motto could just as easily have been "Always in Transition." The National Guard usually was either phasing in or out of a new system, and Regular Army units were doing likewise. During the gun era, the 40mm and quad-50s of the AW battalions were replaced by the automatic 75mm Skysweepers, which acquired, tracked and fired on aircraft from the gun's position. The older M-9 and M-10 fire direction systems were replaced by the M-33.

ARAACOM headquarters were also in constant transition. Periodically, boundaries were redrawn as the units and areas needing protection expanded or contracted. This was never an easy fit since the East, West and Central Army Antiaircraft Commands changed to regions in 1955, and separate brigades often reported directly to ARAACOM.

Command and Control

As the command grew, more intermediate headquarters were required. The division of the country into East, West and Central was no longer practical. In 1955, numbering started to replace geographic locations to designate regions. The 1st, 2nd and 5th Regions (plus the 53rd Brigade) now covered the area once called Eastern ARAACOM. In 1956, Western ARAACOM became 6th Region, and the following year, Central became the 4th Region.

Areas of responsibility between regions and brigades continued to shift throughout the life of the command. At one period, it was important to have ARAACOM regions mirror their North American Air Defense Command (NORAD) region counterparts. This alignment facilitated liaison, operational control and reporting procedures between the Army and the combined command.

Each headquarters had different responsibilities. ARAACOM was initially commanded by a major general. As the command grew in the early 1950s, the position was upgraded to lieutenant general, or the equivalent of an Army corps commander. Like any corps commander, the ARAACOM commander had a general staff that included the usual sections. This unique headquarters continued to grow in the late 1950s to an authorized strength of 222 personnel. The headquarters included sections for the adjutant general, aviation, engineer, ordnance, public affairs and signal, as well as the normal personnel and administration (G-1); intelligence and security (G-2); operations, plans and training (G-3); and logistics and supply (G-4). Although he worked directly for the Army chief of staff, the ARAACOM commander was responsible to other headquarters as well. His operational mission, providing air defense to critical areas of the United States as part of a much larger air defense operation, made his duties as a part of the unified command team paramount to his direct ties to the Army staff. The ARAACOM commander eventually became the deputy unified commander, and as such, of the forces of NORAD if called could command all upon to do so.

The next headquarters in the chain were the sub ARAACOM, later regional, commands. They were commanded by either major generals, brigadier generals or colonels, depending on the location and year. They were equivalent to division commanders, but unlike regular division commanders, did not have a G-staff. Their primary responsibility was to interface with their air defense force or air division counterpart. This interface included providing liaison to air battle control centers that passed early warning and other control statuses to control centers at subordinate headquarters.

Brigades were commanded by either brigadier generals or colonels. They were responsible for defending areas that usually covered several states or major metropolitan areas, such as the Washington-Baltimore defense. As stated earlier, depending on the year and the location, some brigades reported directly to headquarters at Ent Air Force Base.

Groups, commanded by colonels, operated separately or as part of brigade. They covered large defenses of metropolitan areas like Cleveland or vital areas like Hanford where multiple battalions were assigned for protection. Brigades and groups were operationally linked to higher and lower units through their Army air defense command posts (AADCPs). On rare occasions, when separate from a brigade or group, a battalion would operate an AADCP. Battalions were commanded by lieutenant colonels and normally had four firing batteries and a headquarters battery assigned to them. They were the lowest headquarters with staffs. The staffs consisted of the basics for personnel, intelligence, operations, logistics and signal.

The battery was the primary killing element of the defense. The captain or lieutenant in command led the soldiers who manned the guns or missiles, radars and control gear that accomplished ARAACOM's mission of meeting the enemy head on. Most had responsibilities far beyond those of normal company, battery or troop commanders. They usually ran a small military post and community. This post often had its own mini-PX, dining facility and other amenities that required constant attention. In the NIKE HERCULES era, they were responsible for the strict custody requirements of nuclear warheads. These responsibilities, coupled with the awesome mission of guarding the country from air attack, made battery command a formidable undertaking. Separate detachments included command, control and communications (C3), security, aviation and maintenance elements. They could be assigned at any level of the command, depending on mission and location.

Communications

A vital part of any viable air defense network is communications. Many would argue that it is the most essential element, for without it the other elements would have to work independently and would consequently be much less effective. Communications provided the connectivity necessary for the whole air defense system to work.

In the case of ARAACOM, communications consisted of leased telephone lines that transmitted both voice and data and connected all of the command and control elements mentioned above (GCI, SAGE, AADCP, firing units, etc.). Other elements that were too remote for telephone cables, such as the early warning radar sites in Alaska, used the White Alice network. White Alice consisted of a series of 33 sites throughout Alaska that employed microwave relays and "over-the-horizon" or "forward propagation tropospheric scatter" transmissions. Huge antennas would bounce UHF waves off the troposphere to communicate to other ground stations up to 200 miles away.

Of course, picket ships and early warning aircraft relied on radios to pass information. Many other elements that used telephones as their primary communications means also employed radios as backup.

NIKE AJAX

By 1951, testing of the next generation of ground-based air defense weapons had proven very successful. In the preceding six years, the NIKE project had gone from the drawing boards to the intercept of dozens of remotely piloted B-17 bombers over the desert of southern New Mexico. A contract was let with the Bell Telephone, Western Electric and Douglas Aircraft team to produce 1,000 missiles, 60 sets of ground-based equipment (such as launchers, radars and control consoles) and 20 sets of missile assembly equipment for the NIKE-I, later renamed the NIKE AJAX.

In early 1951, the director of guided missiles informed the secretary of defense that immediate acceleration of production processes for the NIKE-I Project was considered necessary to get that missile system out of research and development and into the tactical weapon stage at the earliest practicable date. Following were objectives for this effort: production of 1,000 missiles by December 31, 1952; production of facilities capable of producing 1,000 missiles per month by December 31, 1952; production by December 31, 1953, of sufficient ground support equipment for 20 tactical battalions; and establishment of production facilities that, by December 31, 1953, would be capable of producing sufficient NIKE-I ground support equipment for three tactical battalions per month.

The major elements of the NIKE system were a radar to track the target, a radar for tracking and communicating with the NIKE missile, and the ground guidance computer for developing guidance commands to bring about interception of the target by the missile and for issuing a warhead burst command at the time of closest approach. The search acquisition radar required to complete the system was already under development as part of the M-33 radar-controlled, computerized, integrated fire control system.

Another important radar feature responded to the need for obtaining high transmitter power, with a wide range of tunability, to obtain the maximum protection against jamming. So Bell developed two tunable magnetrons for the NIKE and M-33 track and search radars. One was a 250kw X-band magnetron, the other a 1,000kw S-band magnetron tunable over a 12-percent band.

Both target- and missile-tracking radars were identical, except that the missile track radar was equipped for tracking an X-band beacon in the missile. This radar sent pulse commands with a specific missile address that triggered the beacon, provided pitch and yaw guidance orders and issued the burst command.

The Western Electric North Carolina Works produced 358 ground batteries (sets of equipment) and delivered 14,000 missile control and guidance units to Douglas for assembly in a similar number of NIKE-AJAX missiles. Although the NIKE system was the state of the art at the time, it was not what one would consider "user friendly." As a matter of fact, it could be downright unfriendly. For example, to fuel the missiles with their liquid propellant, which happened to be extremely toxic and flammable, fuel handlers required protection in the form of protective suits made of heavy rubber that covered them from head to toe. These awkward suits were particularly uncomfortable on hot days. However, there was no alternative since fueling operations could result in death or serious injury if something went amiss.

NIKE Training

To train soldiers to operate and maintain this new generation of anti-aircraft technology, the Army established a guided missile department at the Anti-aircraft School, Fort Bliss, Texas, just south of where the NIKE testing was taking place in New Mexico. The overall objective was to train a small cadre of officers and soldiers to run a NIKE battalion. Once this cadre arrived at its permanent location, its numbers would be supplemented with other soldiers who would then be trained on the job.

One of the major challenges facing the Army in deploying dozens of NIKE battalions in just a few years was training the thousands of soldiers needed to man these systems. The NIKE Package Training Program at Fort Bliss met this challenge.

The First Guided Missile Group, better known as the NIKE Group, had as its subordinates the First and Second Training Battalions. Their responsibilities included training "packages" of 14 officers and 123 enlisted men to be the nucleus of each NIKE battalion. Prior to this five weeks of package training, individual groupings had specialized training of differing degrees. Eighty-nine of the package would graduate from the eight-week Specialist Training Program, which prepared them for the routine operation of the NIKE system from emplacement, energizing and alignment to missile loading and target tracking.

The remaining 34 enlisted men of the package and the 14 officers were trained in the maintenance and repair of the NIKE system. Two of the officers graduated from a 31-week course at the Artillery School, the highly technical 1181 Course, and were awarded the title of guided missile systems officer. Another essential course was the 1177 Course that trained guided missile maintenance officers. The remaining 12 officers attended a 15-week course.

Once these groups came together, they spent five weeks on integrated system training as a team. They were issued two sets of battery control equipment, one of which they took 165 miles north of Fort Bliss to Red Canyon Range, NM, to culminate their training by firing a live missile. After this final phase of their training was complete, they returned to Fort Bliss and usually moved their equipment via the railroad to its final destination to protect one of the nation's vital areas.

Trained mechanics and operators, coupled with NIKE system production, resulted in the first deployment of a NIKE unit to Fort Meade, Md., in December of 1953.

In less than a year from that date, 17 battalions of NIKE would be deployed throughout the States, with full deployment realized just three years later when 244 batteries would be in operation nationwide.

Land Acquisition and Site Construction

Rather than deploy the NIKE batteries to open fields that lacked permanent facilities, like many of the gun battery deployments in 1950, ARAACOM had the Army Corps of Engineers busily involved in land acquisition and construction prior to moving soldiers and equipment on sites.

An insight into the problems associated with the construction of NIKE sites can be gained from an Army Corps of Engineer officer who wrote an article titled "NIKE Deployment." "On many of the hilltops surrounding the industrial and strategic centers of the United States," he wrote, "fenced-in assemblages of whirling radar antennae, small buildings and olive drab trailers have appeared." He described the layout of a battery as: "The ground control guidance equipment is located in a plot of six to eight acres --the Control Area-- which includes, basically, three radars and a computer. A Launcher Area is located one to four miles away from the Control Area. It consists of approximately 42 acres, of which 15 acres are required for the operating facilities and the remainder as a surrounding safety zone. The battery comprises six officers, two warrant officers and 101 enlisted men who man and operate these facilities continuously."

Site planning and construction, he continued, required "a multiplicity of activities: enactment of legislation to provide funds for acquisition of land and construction of battery positions and servicing facilities; dissemination of public information to assist in acquiring NIKE battery sites; construction of permanent sites involving hundreds of construction contracts and material suppliers. An architect-engineer contract was then awarded to prepare standard plans of a typical battery installation. Considerable progress had been made by ARAACOM, with the assistance of the Corps of Engineers real estate personnel, in the selection of battery sites." A decision was made to move the batteries closer to the center of the areas they were to defend, therefore, "toward the more highly developed suburban fringes of major cities, the problem of locating sites became more difficult."

So an underground missile storage magazine with a hydraulic elevator was designed and installed on a majority of the sites, thus minimizing the amount of land required from 103 acres to 40 acres in the launcher area. With the missile on the elevator, four missiles per magazine would be made ready for firing prior to the engagement and the original idea of a central battalion assembly area was abandoned.

Selection of sites and land acquisition were major problems. Maximum use was being made of public lands, even though using such sites often violated tactical considerations and resulted in less than optimum defense. By far the greatest number of battery sites had to be located on privately-owned land and, in most instances, high real estate costs and adverse reaction by owners made the acquisition problems acute. The general public often thought that site selections were made either arbitrarily or capriciously and, while almost everybody favored NIKE, almost nobody wanted a unit located next door. It was found to be wiser to construct facilities of a higher architectural standard, thus reducing maintenance and operating costs, improving troop morale and providing buildings acceptable to park commissions and residents of suburban areas.

Normally, the impact of a military construction project on the public is confined to a small area or region. This one, however, extended across the United States and involved countless municipal officials, civic groups, members of Congress and private citizens. Valuable property (including park-ways, recreational centers, private estates and industrial lands) was being sought. Public relations was fixed with the Army commanders of the respective areas.

Several factors made it necessary to provide personnel accommodations and related facilities of better quality than those

originally planned. Taken into account was low troop morale, causing a low re-enlistment rate, and the long, tiresome hours of troop duty at NIKE units without the opportunities for recreation and diversion common to other service installations. It, therefore, became imperative to provide the troops with good living quarters and mess halls, day rooms, hobby shops, post exchanges and athletic facilities. Access roads, hardstands and walkways, originally designed for unfinished gravel surfaces, had to be redesigned for paving with blacktop.

Consideration was given to the architectural appearance of the structures and judicious use of screen and shade planting. This meticulous planning and preparation for construction paid off in the long term, since many of the sites were in use 24 hours a day for the next 20 years.

Readiness

Once trained soldiers and tested missile Systems were joined and deployed to newly constructed tactical sites, keeping them ready to fire at a moment's notice was another challenge that the command faced. Gun and missile crews had to maintain a vigilance in peacetime not previously experienced by the Army.

Since each battalion consisted of four batteries, the readiness posture was shared and rotated among each. One of the four had no more than 15 minutes from notification to fire a missile, two of the remaining three had 30 minutes to fire, and the last had two hours. These different times to fire were called states of readiness (SORs) or, in soldiers' parlance, "pulling state." This meant that at any one time, 75 percent of all the Army air defense forces had crews on site pulling state, ready to activate their systems in case of a surprise attack. This sense of vigilance, purpose and mission lasted for 20 years and gave the soldiers a real sense of protecting their country. They took this responsibility professionally and seriously.

To ensure units remained ready to fire, higher headquarters performed a series of inspections. One "no-notice" type of inspection was the operational readiness evaluation (ORE). An ORE team would arrive any hour of the day or night and tell the crew to prepare to fire by using the code phrase "Blazing Skies," a peacetime term that represented the wartime "Battle Stations." The crew then had the prescribed SOR time to get the system ready for firing. Crews seldom walked through these drills, because the unit's reputation lay on the line. Good units could pass OREs if the system didn't fail them, and those that couldn't were usually locked on their site for retraining until they could pass. These measures, designed to improve operational readiness, had a far-reaching effect. Because of them, NIKE batteries assumed an almost combat like role. Fifteen-minute status permeated the atmosphere of a NIKE site. A siren meant an exercise, a readiness test or an attack; one never knew. As ARAACOM units met these statuses 24 hours a day, they assumed an ever-increasing feeling of responsibility for the nation's defense.

Other training events included monthly air defense exercises, lasting 24 hours, where the command and control network from the early warning radars to the firing units was tested and exercised. Another major event had each firing battery annually returning to New Mexico's Red Canyon Range to fire a missile. During the annual service practice (ASP), the soldiers had to perform thousands of individual checks, operations and adjustments nearly flawlessly to achieve the "Honor Battery" rating, a coveted prize.

The ASP was an anticipated event. Units knew the dates they would be firing and practiced hard during the weeks preceding travel to the firing range. To make it more challenging and, in theory, have the units practicing year-round, the "Short Notice" Annual Service Practice, or SNAP, was adopted. Like an ORE, it was a surprise to the unit, and they had only a few hours before traveling to New Mexico for evaluation and firing.

A firing unit's schedule included much more than pulling state, OREs, ASPs and SNAPs. The commander of the 3rd Battalion of the 5th ADA, located in Massachusetts and Rhode Island, listed the following events, in addition to those above, as taking place during a typical year in a NIKE unit: "Tactical evaluations, command maintenance management inspections, radar bomb scoring, annual general inspections, annual training inspections, annual command inspections, technical proficiency inspections, technical standardization inspections, security inspections, annual penetration attempts, and support of command programs such as safety, cost reduction, etc." Although these tasks were performed to check certain aspects of unit readiness, every one depended on troop performance. But all work and no play would soon wear out a unit and the result could be more failures than successes. So sports programs and recreation were an important part of unit activities. Competition in swimming, volleyball, flag football, basketball, marksmanship, bowling, golf, softball, pool, tennis and archery took place between batteries within a battalion and at the group, brigade and regional levels. One site at Grand Island, NY, even had its own miniature golf course. At Red Canyon Range, soldiers spent their spare time, weekends and holidays scrounging materials to build a chapel. They salvaged steel rails from Southern Pacific for the frame and cut bracing from the steel doors of the Lincoln County jail. The interior walls and roof came from the tips and sides of NIKE booster crates. They quarried rock from a nearby canyon or the exterior walls and used plastered telephone poles as the pillars on the front entry. Using cellophane and shellac, they simulated stained glass windows. For bells they hung three NIKE boosters in the steeple. The boosters had been fired and the heat gave them a pleasant resonance.

Automated Command Posts

As long as the numbers of enemy aircraft remained small, all that was envisioned was to bring up the air defense network and defend those areas assigned. However, when the threat grew and became more sophisticated, command and control of air

defense forces posed new problems. With the enemy flying multiple sorties at different altitudes and many different directions, and our own aircraft flying to intercept, how could they all be sorted out? The Army's answer was special command and control operations centers that had soldiers monitoring different early warning devices, then communicating both automatically and by voice to those units that would actually engage the enemy.

As background, Army air defense operations throughout the years pointed up the need for a system that would provide timely and continuous information to the fire units about the location of friendly and hostile aircraft and for rapid exchange of information between fire units and the AADCP. Immediate collection and dissemination of target data were required to ensure rapid fire unit response and concentration of effort directed toward the enemy threat. During World War II and until the mid-1950s, this was accomplished by using voice, telephone and radio systems to pass information from one element to another. Manually operated plotting and status boards were used to develop and portray the air defense situation to Army air defense commanders at various echelons. Such slow and cumbersome Systems did not meet the need for rapid transmission of information required for quick defense reactions needed to destroy jet aircraft by surface-to-air guided missiles.

To meet this need, the U.S. Army developed the electronic fire distribution system, Missile Master, which became operational in 1957. It provided a rapid and accurate flow of information between the AADCP and its associated missile fire units. Interchange of information was also made between adjacent AADCPs and the Air Force's SAGE system. Target track information and commands were transmitted as digital data via automatic data link (ADL) between the AADCP and missile fire units. At the fire units, track information and commands were converted from digital data and presented on the fire unit commander's display console. Using electronic displays and controls at the AADCP, the air defense commander (usually a group commander) could monitor or direct the actions of 24 fire units against targets.

Major items of equipment in the Missile Master system included a defense acquisition radar (DAR) or similar radar, two height-finder radars, a tracking subsystem, a tactical display subsystem, ADL transmitters and receivers, and computing and storage equipment.

Two other fire distribution systems were developed: the BIRDIE and the Missile Monitor systems. BIRDIE was a compact, transportable system that functioned in a manner similar to Missile Master. Missile Monitor was developed to coordinate the fire of batteries with the Army in the field.

Note: On March 27, 1957, the Army Antiaircraft Artillery Command (ARAACOM) changed its name to the US Army Air Defense Command (USARADCOM). On May 1, 1961, it adapted a simplified acronym, ARADCOM. To avoid confusing the reader, the text hereafter refers to the command as ARADCOM.

NIKE HERCULES

In June of 1958, the first NIKE HERCULES battery became active in the Chicago defense. By strapping four of the AJAX boosters together, HERCULES increased the range of the NIKE nearly threefold. The top stage of the missile was also larger to accommodate more propellant and bigger warheads, including nuclear munitions. With NIKE HERCULES, ARADCOM could destroy hostile aircraft at greater distances in greater numbers. The atomic warhead could allow one missile to destroy entire formations of bombers.

The Army asked Bell Laboratories in 1953 to continue to study possible improvements in the NIKE system so that its effectiveness might be increased against all types of future bomber attack strategies. An important concern was the danger that closely spaced bombers could degrade the ground target angle accuracy and present high-traffic levels that could saturate the NIKE-AJAX system. The Army wanted a larger missile that would be capable of carrying a nuclear warhead and also wanted to extend the range of the system from 25 to 50 miles. (As it turned out later, the missile developed had a range of 100 miles and improvements in ground equipment alone actually increased the system range from 25 to 100 miles.) The kill radius of such a warhead would force any enemy to space its attackers to avoid multiple losses. The resulting system change in NIKE-AJAX, initially called NIKE-B and later NIKE-HERCULES, was made so that the ground system could fire both NIKE-AJAX missiles and the larger, longer range NIKE-HERCULES missiles from the same battery. The NIKE-HERCULES system was designed for continental United States and field operation in three different modes: surface-to-air, low-altitude and surface-to-surface. Modifications were made to the radars to give them greater range than their AJAX counterparts. Communication between the missile tracking radar and the HERCULES missile was also improved. Another significant improvement was the replacement of liquid fuel with solid propellant. As mentioned previously, the most hazardous operation in a NIKE unit was to fuel up the rocket motor. Eliminating liquid fuels improved maintenance, safety and availability of missiles.

Unlike AJAX, HERCULES contained no vacuum tubes, only solid state components except for the beacon transmitter. This enhanced the reliability of the system and eliminated thousands of tubes that had to be carried in supply.

Western Electric North Carolina Works produced a total of 393 NIKE-HERCULES ground systems and more than 9,000 guidance units for the Douglas HERCULES missile. Although the majority of these systems were used in the United States, some were deployed in Europe and the Far East, primarily South Korea.

Summary

To summarize this decade in terms of threat, the nation, the military and ARADCOM, this phase of deployment and growth in ARADCOM saw a leap from the post-World War II propeller-driven bomber threat to jet-powered intercontinental bombers and the early stages of a ballistic missile threat. A national strategy was formed, reworked and massaged in the light of competing domestic needs. The military now saw continental defense against air attack as a top priority and allocated resources accordingly. ARADCOM had moved from the gun era to the missile era with a massive deployment of hundreds of sites manned by thousands of highly skilled soldiers.

Chapter One

Chapter Two

Chapter Three

Chapter Four



CHAPTER THREE: Peak Deployment-The 1960s

The decade of the 1960s was one of peaks and valleys for the United States. The confident nation that began the decade with its eyes on a bright and seemingly unlimited future reached the end of the 1960s in disillusionment and disarray, its unity, institution and sense of moral certainty disrupted by its most unpopular and divisive foreign war. This negative transformation had a significant impact on the military as a whole and, especially, the future of ARADCOM.

The Soviet Union continued to build its strategic might to new heights. Khrushchev's desire to outpace the United States in ballistic missiles of every variety was significantly increased when he lost face when he was forced to back down during the Cuban Missile Crisis. The Soviets, however, did not by any great measure increase their strategic bomber forces, which left the massive U.S. defenses guarding against them open to controversy and eventually to cutbacks.

Early in the decade, the United States elected a new president who promised a challenging future. John F. Kennedy was soon embroiled in a direct confrontation with the Soviets over their Cuban missile deployments. After Kennedy's assassination in 1963, it was left to Lyndon B. Johnson to wade into the morass of Vietnam. Despite his spectacular success in pushing a flood of domestic social legislation through Congress, the storm of protest over Vietnam so eroded Johnson's ability to govern that he decided not to run for re-election in 1968. Richard Nixon then made the critical decisions on the future of the U.S. military.

The part of the military entrusted with defending the United States against air attack reflected the ups and downs of the nation. By the early 1960s, NORAD achieved its most robust capabilities with the advent of new, modern systems. The near offshore threat of Cuba created a renewed vigilance and sense of purpose. But the 12-year war in Vietnam that sapped the nation's will also drained resources that, otherwise, might have gone to strengthen the country's air defenses.

This decade saw ARADCOM achieve maximum deployment early in the 1960s, then begin the process of downsizing. It continued to modernize with the inactivation of its last gun units, upgrading from NIKE AJAX to NIKE HERCULES, then finally to the Improved NIKE HERCULES system. It added additional command and control capabilities. Missile Master systems were used for the large area defenses, and BIRDIE systems for the medium and smaller defenses. ARADCOM assumed command of the missile forces deployed to Florida for the Cuban crisis, and for the first time, brought the long-awaited HAWK system under its control.

As Vietnam drained the country, it also drained ARADCOM. Stateside units became the bill payers for the war in terms of manpower and dollars. As the antiwar, antimilitary sentiments took hold, the United States began to inactivate parts of the air defense network.

ARADCOM saw its future in terms of still guarding against the old bomber threat, but counted on being able to evolve into ballistic missile defenses as the wave of the future. Therefore, NIKE ZEUS became the follow-on to NIKE HERCULES, much as HERCULES was the follow-on to AJAX. But the deployment of antiballistic missiles became a political football that traveled up and down the national playing field during the 1960s.

The Threat

The Soviet Union moved up from a distant second place in the nuclear arms race at the beginning of the 1960s to a position of parity with the United States at the decade's end. A primary stimulus for this growth was the miscalculation on the part of the Soviet premier who attempted to deploy ballistic missiles to Cuba. The Soviet Union prepared to deploy medium-range ballistic missiles to Cuba in 1962, not knowing that the United States would severely object. That mistake led the world to the brink of war, caused Khrushchev to eventually be ousted from power and launched Soviet efforts to build a mammoth nuclear capability to prevent having to deal ever again from a position of weakness. Meanwhile, the Soviets erected barriers that restricted movement in the Eastern Bloc of nations and assisted the communists in Vietnam. All of these events would ultimately affect ARADCOM.

Ballistic Missile Buildup

The shift from bombers to ballistic missiles that began in the late 1950s was reality by the 1960s. Intelligence estimates had made still another reduction in the Soviets' operational heavy bomber strength, and Khrushchev had strongly implied that few, if any, future bombers would be produced. While the Eisenhower administration had begun to reject the "missile gap," there seemed little doubt that the intercontinental ballistic missile (ICBM) would become the predominant threat by the mid-1960s.

The Soviet's strategic plan further emphasized this point. In a speech to the Supreme Soviet on January 14, 1960, Khrushchev declared that a future war would begin with missile attacks deep into a country's interior and that many traditional military forces should be replaced by nuclear weapons and missiles.

In the year preceding this speech, he created the Strategic Rocket Forces, which were considered the preeminent service over the ground, sea, air defense and other air forces. So the stage was set for the proliferation of nuclear-tipped ballistic missiles

to come. But the fact of the matter was that the Soviet Union was strategically inferior to the United States. For example, the missile deployed in the late 1950s and early 1960s, while useful in a theater mode, had no relevance as an intercontinental system. Furthermore, even when the first ICBM, the SS-6, was deployed, it was clear to the Soviet leadership that it was vastly inferior to the U.S. Minuteman. In a nutshell, Moscow was still not in a position to meet what it perceived as the U.S. threat.

Khrushchev adopted a threefold strategy to deal with the U.S. "threat." First, he emphasized the deployment of large numbers of increasingly sophisticated long-range missiles, as well as augmenting Soviet air defense. Second, the Soviet Union began to show interest in arms control negotiations, not only for propaganda purposes, but as a vehicle for retarding U.S. weapons programs. Thus, despite Khrushchev's heavy use of arms control for propaganda purposes, he signed the Limited Test Ban Treaty of 1963. Third, Khrushchev attempted to rectify the strategic balance over the short term by placing medium-range tactical missiles in Cuba in the fall of 1962. His view of deterrence was based on a secure retaliatory capability, and he probably hoped to undercut his military critics at home by establishing a credible theater deterrent while effective long-range systems were being developed. The failure of the plan was one of a number of factors that led to his ouster in 1964.

Soviet strategic doctrine was far in advance of available technology. To put it bluntly, Moscow's strategic forces were not up to the task assigned them, a fact that was made clear to the Soviet leadership not only by the Cuban incident, but also by the Berlin crisis, the sharp deterioration of relations with China and the adoption of a flexible response strategy by NATO. Nevertheless, the foundation for a massive buildup in strategic weapons had been laid, but it wasn't until the Brezhnev period that the strategic Systems called for in Soviet doctrine began to enter Moscow's weapons inventory in substantial numbers.

Great efforts were made during this post-Cuban crisis period to build up Soviet strategic forces. The budget for research and development in strategic weapons was increased significantly. Work was intensified on the development of an antiballistic missile (ABM) system, a multiple independent re-entry vehicle (MIRV) and newer missiles, to cite three cases. In addition, the number of ICBM launchers was also increased. For example, in October 1966 the Soviet Union had deployed 340 ICBMs. A year later the number had risen to 720; by 1968 it stood at 900, and by 1969 it was 1,060.

New types of missiles were deployed in dispersed and hardened silos. One of these missiles, the SS-9, was liquid fueled, carried a 20-megaton warhead and had a range estimated at 6,500 nautical miles.

The Soviet Navy also grew during this period. In 1968, the Soviets introduced a new class of nuclear-powered submarine with 16 tubes and equipped it with SS-N-6 Sawfly missiles with a range of 1,300 nautical miles for strike missions against targets located in the United States' coastal areas.

No new intercontinental bomber was developed during this period. The Soviet leaders continued to rely on the Bears and Badgers that had been deployed during the 1950s. The intermediate-range Backfire bomber, however, was under development.

Another Soviet capability that became a factor in the ABM debate was the deployment of the Galosh ABM system around Moscow. U.S. ABM advocates saw the Galosh as a cogent reason for deploying a similar U.S. ABM system. The Galosh, which consisted of 64 missile launchers and associated radars and command and control apparatus, was first deployed around Moscow in the mid-1960s. US strategic intelligence anticipated that this Soviet ABM capability was only the first step in deploying a much more robust ballistic missile defense.

The Chinese "Threat"

Another communist country that caused the deployment of a U.S. ABM system was the People's Republic of China, or Red China, as it was known in the deep freeze of the Cold War. It became a nuclear weapons state on October 16, 1964. The Chinese nuclear weapons program had received some nuclear technology from the Soviet Union before these two nations had their falling-out in 1960. In 1967, China exploded its first fusion bomb. Consequently, in 1967, a commitment was made to deploy the NIKE X in the SENTINEL system to guard U.S. cities primarily from a possible small-scale nuclear missile attack by Red China.

Another way that the two dominant communist powers affected ARADCOM was that both the Chinese and the Soviets supplied the United States' enemy in Vietnam. This limited-war involvement had a major impact on resources used to carry on other Cold War activities, like the defense of North America from attack.

To summarize, during this decade the Soviet Union achieved a robust nuclear capability. The implications of the massive increase in intercontinental and submarine-launched ballistic missiles opened a great debate over whether or not the United States should deploy systems to defend against them. In addition, the aggressive and nuclear-capable Chinese became another factor in the ABM equation.

The Nation

Turbulence and change racked the United States during the 1960s. Besides four different presidents, two of them leaving office through either assassination or refusal to run again for a second term, the nation was brought to the brink of nuclear

war over Cuba, became bogged down in the quagmire of Vietnam, and was emerged in a hot debate over the fundamentals of strategic nuclear deterrence and defense.

Eisenhower, Kennedy, Johnson, Nixon

During President Eisenhower's last year in office, pilot Francis Gary Powers was shot down over the Soviet Union while flying a U 2 spy mission. In a complex series of events that followed, a worldwide alert of U.S. communications was ordered. This would be a minor prelude to things to come.

President Kennedy's confrontation with the Soviets was more open, and the alert posture of U.S. forces many times more severe. Between his inauguration in January 1961 and his assassination in November 1963, he led the nation in both open and indirect confrontations with world communism: from the abortive Bay of Pigs invasion to the Berlin Wall, plus escalation and, finally, the Cuban Missile Crisis.

The Cuban Missile Crisis cast light on several vulnerabilities of the U.S. air defense scheme. First, the NORAD defenses were oriented for a likely Soviet attack over the North Pole, and the southern flank of the United States was vulnerable. Second, since the United States had no ABM capability to counter the theater and intermediate-range ballistic missiles that the Soviets were attempting to deploy to Cuba, its only defense was to prevent deployment. The first vulnerability was corrected within days by deploying radars, interceptors and Army air defense units to the southern flank. On the second, President Kennedy forced Premier Khrushchev's hand and prevented deployment.

Lyndon B. Johnson's administration struggled with building a "Great Society" while simultaneously getting deeply involved in an undeclared war in Vietnam. His feeling of impotency in dealing with these and other domestic problems led to his decision not to run for a second elected term of office. Richard Nixon won by an overwhelming majority, in large part on his promise to achieve "peace with honor" in Vietnam.

The ABM Debate

Another thread woven throughout the decade was the debate over deploying defensive systems against the ever growing ballistic missile threat overwhelmingly posed by the Soviets and to a much lesser degree, by Red China. This debate centered on four basic interpretations concerning the role of ABMs. The first interpretation projected a genuine defense against the offensive might of the Soviet Union and China. In this view the ABM system needed to serve as an area defense (affording protection for thousands of square miles) as well as offer terminal defense protection (permitting a more intense coverage for a few hundred square miles).

A second interpretation had ABMs as the protectors of America's offensive forces around U.S. land-based Minuteman ICBMs. In the remaining two, ABMs were also viewed by different camps as a symbol of the arms race and as an alternate avenue of arms control and disarmament.

ABMs were a political hot potato and attracted the attention of the antiwar and antimilitary factions later in the decade. Robert McNamara, the secretary of defense during the Kennedy and most of the Johnson years, became the center of controversy. He vacillated between full deployment and no deployment, depending on the political winds. In a speech on September 18, 1967, he both denied the need for ABMs and talked of a "light defense" in case the Chinese attained an intercontinental capability.

In the midst of the heated ABM debate four major decisions were made: the McNamara decision in April 1961 to defer production and deployment of the Army's NIKE-ZEUS system; the McNamara decision in January 1963 to phase out NIKE-ZEUS and to initiate research and development of a more complex and sophisticated ABM system called NIKE X; the Johnson decision in September 1967 to deploy the SENTINEL ABM system; and the Nixon decision in March 1969 to deploy the "hard-point" ABM system known as SAFEGUARD.

The Military

The role of the U.S. military came into sharp focus during the 1960s. The massive buildup that took place during the previous decade, coupled with several international crises and especially the war in Vietnam, brought the military to the center of national attention and controversy.

The forces of the United States were involved in many different kinds of operations: a re-emphasis on Europe as a result of the Berlin Wall construction; an orientation to Florida and the Caribbean as a result of the Cuban Missile Crisis; and the deployment of soldiers and marines to the Dominican Republic, Lebanon and, at home, in Mississippi, Alabama, Los Angeles, Detroit, and other centers where civil unrest erupted, first over racial integration, then over antiwar protests. Yet all were minor in comparison to the war in Vietnam. An undeclared war with no definite beginning and an even muddier ending, it caused a shift in focus away from strategic defense and saw those forces become the bill payers.

Improved Air Defenses

Before this massive involvement in Vietnam, improvements planned a decade earlier came to fruition within the continental defense community. The 1960s saw the deployment of a very sophisticated radar network called the Ballistic Missile Early Warning System (BMEWS). The system employed huge radars, each about the size of a football field standing on edge, and consisted of eight detection radars providing two fans of surveillance from four fixed antennas and a tracking radar. Its fans of radar coverage ranged out for more than 3,000 miles in twin beams that, when penetrated by missiles, helped establish trajectories of the ICBMs. BMEWS could give 15 to 20 minutes warning between the recognition of an attack and the impact of ICBMs. Three BMEWS sites, in Alaska, Greenland and England, were built.

NORAD now deployed a robust family of interceptor aircraft. Dozens of squadrons of CF-101s, F-101s, F-102s and the long-range supersonic F-106 flew as part of the defense. The Navy integrated their F-4H into NORAD defenses also.

The Air Force completed the installation of SAGE, with a total of 22 of these advanced command and control nodes installed. These 22 nodes were tied directly to NORAD's Combat Operations Center, which moved to Cheyenne Mountain from Ent Air Force Base in 1966, and maintained surveillance, identified aircraft, selected and directed intercepting aircraft, coordinated air defense responses and disseminated air defense intelligence. SAGE systems were located at Sector Direction Centers. The SAGE automatic data-processing capability substituted for manual GCI systems in observing, plotting, transmitting information and assigning targets for air defense weapons. Since detection and command and control in NORAD grew more robust, the Navy was able to reduce its participation in NORAD. The Navy pulled its picket ships and blimps from the DEW network and disestablished Navy Forces, CONAD in 1965.

As these deployments of forces and new systems ensued, the National Command Authority struggled with the question of whether or not to actively pursue a ballistic missile defense. Opponents dwelled on the technology angle, claiming a BMD was not possible, and if the technology could finally be achieved, it could be overwhelmed by more advanced offensive systems. Meanwhile, scientists and engineers built the NIKE ZEUS missile, which intercepted an orbiting satellite over the Pacific in 1963.

ARADCOM

This decade saw the Army Air Defense Command modernize, expand to defend Florida and other locales within the United States, continue the role of the National Guard, become a replacement pool of sorts for Vietnam, make plans for ABM, and then begin inactivating defenses in the late 1960s.

Modernization

In June of 1960, the last Skysweeper battalion in ARADCOM inactivated at Camp Lewis, Mich., thus completely ending the gun era. At that snapshot in time, ARADCOM had 88 NIKE HERCULES batteries and 174 NIKE AJAX batteries, with 52 of the latter manned by National Guardsmen.

ARADCOM's modernization continued throughout the 1960s. The first-generation AJAX systems were phased out in favor of the HERCULES systems. The commanding general of ARADCOM, Lt. Gen. William Dick, explained the advantages of HERCULES in a speech to the Army War College in 1963:

The HERCULES surpasses the AJAX's capability in range, velocity, low- and high-altitude performance and general lethality. It has a range of more than 75 nautical miles, an altitude capability of more than 100,000 feet and has destroyed targets flying faster than 2,000 miles per hour. Carrying a nuclear warhead, NIKE HERCULES can kill close formations of aircraft at a distance greater than the single target kill distance of NIKE AJAX.

NORAD's emphasis is on nuclear warheads to assure "weapon" kill as well as "carrier" kill. If the nuclear weapon in an attacking bomber was equipped with a "dead man" fuse, killing the weapon carrier would not necessarily prevent explosion of the enemy weapon. We feel it is essential not only to knock down the target but to neutralize its nuclear payload.

Now being deployed is an improvement to the NIKE HERCULES system. ARADCOM is moving to give the system a capability against smaller and swifter targets, including missiles launched by standoff bombers and submarines....

The improvement program essentially adds two new pieces of equipment. One is the High-Powered Acquisition Radar (HIPAR), a multi-megawatt radar that is able to detect, at long range, targets of a small radar cross section, or reflective area. HIPAR will also enhance HERCULES' capability in an electronic countermeasures environment. The second piece of equipment is the Target Ranging Radar, TRR, being added to provide range information and frequency diversity in the target-tracking function....

As is evident from the discussion above, new developments have made profound impacts both upon NORAD doctrines and NORAD operations. Our existing anti-bomber system is rooted deeply in the austerity of the 1950s. When HERCULES units came into the inventory, they were deployed, principally because of budgetary restrictions, to sites formerly occupied by NIKE AJAX units. Assuming the role of Monday-morning quarterbacks, we can say now that this decision was not sound. While anti-

bomber defenses were measurably strengthened, the full potential of the new HERCULES system was not harnessed. Moreover, imperceptibly at first then with astonishing rapidity, the threat was becoming more and more sophisticated. Today, we find our NIKE HERCULES units sitting right on top of likely targets where, if these areas are hit by enemy ICBMs, anti-bomber NIKE forces will be destroyed.

Two other Army air defense missile systems are worth mentioning here. First, the HAWK low- to medium-altitude system came on the scene in 1959. ARADCOM actively sought to have HAWK battalions integrated into its NIKE defenses. They saw HAWK as keeping the bomber threat from sneaking under its defenses, and therefore requested that HAWK be sited in nearly every defense. Due primarily to lack of funds for such a widespread deployment, HAWK was never fielded as ARADCOM planners had envisioned, although two battalions were allocated to ARADCOM as a result of the Cuban Missile Crisis.

Another missile system on the drawing boards was the AADS-70, later called SAM-D and finally called PATRIOT. With its phased-array radar and ability to simultaneously engage multiple targets, it was to have a dual capability against aircraft and ballistic missiles. This latter requirement was dropped as a result of the ABM Treaty, then added again as a result of the Strategic Defense Initiative of 1983. This system was seen as the successor to the single-kill HERCULES and HAWK systems.

In addition to upgrading each HERCULES battalion's capability to acquire, intercept and destroy, command and control improvements were made also. This was made possible by significant advances in radar and electronic countermeasure and electronic counter-countermeasure technology fields.

The initial concept was to have SAGE automatically pass information to the Army's Missile Master Systems, located in each major area defense. Like SAGE, Missile Master was found costly to install, operate and maintain. It also suffered from being overly capable since it could handle 24 batteries at one time. When defenses deployed fewer batteries because of the transition from AJAX to HERCULES (for example, from 12 AJAX to three HERCULES batteries in the Niagara-Buffalo defense), the maximum capabilities of Missile Master were not required. Missile Master also experienced a siting problem, usually in the center of a defense, close to ground zero of an incoming ballistic missile strike.

The solution to this dilemma was found in the BIRDIE system, which handled fewer units and was less expensive to install and maintain. A follow-on system to Missile Master was also developed, designated the AN[TSQ-5 I, or a long title, CONUS Air Defense Fire Coordination System. The Florida defenses used yet another system, called the Missile Monitor, which they inherited from their days with a field army.

But whether the fire distribution system was a Missile Master, one of the two versions of the BIRDIE, an AN/TSQ51 or a Missile Monitor, all were assigned to the AADCP. This was the command and control heart of any Army area air defense network. An AADCP employed any one of these automatic fire distribution systems and manual backup systems, consisting of Plexiglas tracking boards, overhead projectors, radios and telephones.

Florida Defenses

Although none of the Army air defense battalions that rushed to Florida in October 1962, during the Cuban Missile Crisis, were from ARADCOM, only five months after their arrival they were permanently assigned to the command. Much like the rush deployment of gun battalions in 1950 during the Korean War, these HAWK and HERCULES battalions occupied unprepared positions. "Hurricanes and humidity, coral and glade, snakes and mosquitoes: all of these... posed special problems for the isolated defenders of Homestead-Miami and Key West."

The 6-65 HAWK Battalion, which defended Key West, was less than 100 miles from Cuba. The 8-15 HAWK and 2-52 HERCULES Battalions ringed the Homestead-Miami area. All were elements of the 13th Group. These two HAWK battalions presented unique challenges to ARADCOM, "in mission assignment, as well as in operational, logistical and personnel matters - hitherto foreign to a command armed solely with the NIKE HERCULES system."

As ARADCOM had done the previous decade, it took on the task of organizing makeshift defenses and integrating them into the fold. It analyzed the threat, focused great emphasis on command and control (because of the short distance from Cuba to the United States), constructed permanent housing to get the soldiers out of tents and weathered several severe hurricanes. It also had to conduct tough training and maintenance of missile systems assaulted by salt-laden and often high-intensity winds while maintaining morale. But ARADCOM's previous 13 years of experience on fixed Sites allowed its programs, this time, to proceed at a rapid pace.

Expansion

By 1960, ARADCOM defended 23 vital areas consisting of about 250 communities in 30 states of the union. Defenses varied in size, depending on the nature and importance of the areas to be protected. Some defenses had as few as two batteries while others had more than 20 batteries. Some 35,000 officers and enlisted men manned these batteries.

ARADCOM continued to expand its coverage of the United States in the early 1960s. In addition to the Florida defenses, the 64th Group, with its five battalions, was activated in Camp Wolter, Texas. Three battalions were located in Texas metropolitan centers, including the Dallas-Fort Worth metroplex, Austin and Abilene. The other two battalions were located at Shreveport, La., and Roswell, NM. Also, the first above-ground NIKE HERCULES site became operational at Byron, Ga., near Robins Air Force Base. At its peak in 1963, ARADCOM deployed a total of 134 NIKE HERCULES batteries.

The National Guard

National Guard units continued to play a key role in operating the systems of ARADCOM. The 1966 version of the Air Defense School's Digest summarized the role of the Army National Guard in ARADCOM in these words: "The Department of the Army authorized the Army National Guard to convert 32 AAA battalions, then equipped with conventional guns, to NIKE AJAX missile battalions in 1957. The 4th Missile Battalion NIKE AJAX, 251st Artillery, California Army National Guard, was the first National Guard surface-to-air guided missile battalion integrated into the active continental United States defense mission. This unit assumed around-the-clock operations at four battery sites in the Los Angeles area on 14 September 1958. At the completion of the phased training program, the Army National Guard was furnishing 76 batteries in 14 states, defending 15 areas. These were the first U.S. Reserve forces with modern surface-to-air missiles."

In May 1962, the first of the Army National Guard NIKE AJAX units were phased out and started retraining to operate and maintain the second-generation NIKE missile, the nuclear-capable NIKE HERCULES. Four units of the Maryland National Guard were selected for the initial conversion to NIKE HERCULES, becoming operational on December 11, 1962.

The last four NIKE AJAX sites manned by the National Guard were phased out in May 1964 at Norfolk, Va. The final stages of the NIKE HERCULES conversion program were completed in 1965 with 48 Army National Guard batteries, representing 16 states and defending 18 areas, participating in the on-site program.

Guardsmen assumed full operational responsibility for manning the sites around the clock. Full-time personnel manned the equipment 24 hours a day, keeping it in constant readiness. This cadre of full-time specialists was capable of initiating effective fire on the enemy without additional personnel. Remaining members of the units were citizens of the community who kept up their military skills by attending regular drills with their units. If an air attack occurred, they were to report immediately to their assigned units.

These Army National Guard units, although an integral part of the air defense system when they became operational in wartime, retained their identity as state units under the command of the governors of their respective states in peacetime. ARADCOM was assigned responsibility for training supervision and support of these units. In event of an emergency requiring use of these units in a combat role, operational command would be exercised by CINCNORAD.

Replacements for Vietnam

Unlike most other Western nations, the U.S. Army did not assign a new replacement to a unit and then leave him there for his career. The Army reassigned soldiers to different units at least every three years. The war in Vietnam, and the policy of rotating individuals in and out every year, disrupted the Army's three-year norm.

ARADCOM became a replacement pool of sorts, having to ante up its fair share of personnel resources. Some of the soldiers in NIKE units did not have NIKE-specific military occupations. Besides missilemen, there were truck drivers, cooks, mechanics, clerks, supply men, etc., who, naturally, were needed and rotated to Vietnam.

Signal Corps personnel were particularly hard hit. They manned communications centers that were never adequately staffed even before the war. They often worked seven days a week and pulled double shifts. Vietnam only added to their disruption. A vast majority opted not to reenlist.

The war also affected the unit leadership. Many of the company and field grade officers who were assigned to Vietnam served not in their air defense field but, usually, as advisors to the South Vietnamese Army. Consequently, junior officers back in ARADCOM got an opportunity to command units and hold down staff positions. Before long, many right sleeves, the authorized location for a combat patch, were adorned with the insignia of MACV - the Military Assistance Command, Vietnam - and other combat commands.

ABM Description

Volumes have been written on antiballistic missiles. And although ARADCOM officially inactivated before the United States' ABM system was fully operational, the ARADCOM staff played a vital role in developing plans for fielding the system they anticipated operating.

Much like the NIKE Systems that preceded it, the ABM system evolved through many stages. The same Bell Labs that produced NIKE AJAX and NIKE HERCULES spearheaded the ABM effort, although many more subcontractors were involved.

America's ABM system was the result of a research and development effort started in 1956. It began with the Army's NIKE ZEUS system, a concept very similar to the other NIKE systems. ZEUS had radars to acquire and track the target and also a radar to track the intercepting missile, as well as a computer. Another radar not found in other NIKE systems was a discrimination radar used to determine which objects being tracked were threatening, because of decoys being mixed with incoming warheads. However, this system suffered from the same problem as other NIKE systems and the HAWK system: it could track and intercept only one target at a time.

The system demonstrated its ability to intercept single objects successfully with its first live intercept at Kwajalein in July 1962.

ZEUS was severely limited by several factors that made its operational deployment impractical. Decoys, chaff, balloons and other means of confusing such an elementary system were conceived or developed. It was limited by its low traffic handling capability. Exoatmospheric discrimination of the incoming objects was impossible and atmospheric discrimination resulted in commitment altitudes that were too low for practical use.

The development and introduction of phased array radars and a high acceleration SPRINT interceptor went far to overcome the NIKE ZEUS system deficiencies. The new radars, using electronic beam steering, relieved almost completely the traffic handling problem of the old radars. The SPRINT, because of its very high acceleration, could now withhold fire until the incoming objects entered the atmosphere. This made possible the use of atmospheric filtering for discrimination of lightweight objects such as chaff, balloons and tank fragments.

These advantages were so desirable that, in January 1961, the old ZEUS was canceled and a new development, NIKE X, begun.

NIKE X

The NIKE X system had two phased array radars, the very large Multifunction Array Radar (MAR) for long-range detection, acquisition and discrimination, and the short-range Missile Site Radar (MSR) for guiding the SPRINT and ZEUS interceptors (the ZEUS interceptor was the only carryover from the NIKE ZEUS).

Defense technology continued to advance in 1964 and 1965. One newly evolved concept used a large nuclear warhead for out-of-atmosphere kills at long ranges (where its effect on the ground would be negligible). To take advantage of this characteristic, a new long-range interceptor was required.

To support this long-range missile a long-range surveillance and tracking radar was introduced, much cheaper than the MAR. The new radar later became known as the Perimeter Acquisition Radar (PAR). It was determined that the PAR and MSR radars and the SPARTAN and SPRINT interceptors could be assembled in many combinations and their deployments could be tailored to meet various threats. Also, it became apparent that the addition of the new interceptor (SPARTAN) with its large warhead permitted, for the first time, a "thin" defense of the entire United States against small threats.

SENTINEL

At the request of the Secretary of Defense (McNamara), the U.S. Army worked up a deployment plan aimed specifically at the supposed Chinese threat. It was believed then (1967), based on the Chinese nuclear test program, that China could have a few operational ICBMs in the early 1970s.

This deployment plan was presented in July 1967. It consisted of several PARs across the northern boundary of the United States and Alaska to perform the long-range detection and acquisition function; MSRs and SPARTAN batteries in the continental United States and Alaska, and one MSR and SPRINT battery in Hawaii. The deployment required several hundred SPARTANs for overall defense and a lesser number of SPRINTs to defend the PARs.

The entire country was thus given an area defense against a first-generation threat. Deployment of some of the complement of MSRs in Minuteman fields provided an option to give some of the Minuteman forces a high quality terminal defense by installing SPRINTs in these fields later.

The investment costs (excluding research and development and tactical operation and maintenance) were estimated to be in the vicinity of \$5 billion. In September 1967, McNamara announced a decision to go ahead on this deployment. It was subsequently named SENTINEL.

SAFEGUARD

The SENTINEL proposal was widely criticized, and after the presidential election the incoming administration Nixon's set up a review of the whole defense concept. The 1976 version of Jane's Weapon Systems continues the history of ABM:

SAFEGUARD is the name that was given to the antiballistic missile system proposed by the Nixon administration as a

replacement for the five-billion-dollar SENTINEL program.... The SAFEGUARD proposal involved the deployment of up to twelve sites, of long-range and short-range ABM missiles to provide a limited defense in depth against incoming ballistic or fractional-orbital bombardment missiles.

Whereas the original SENTINEL proposals were for a comprehensive defense system giving substantial protection both to the civilian population and to the deterrent forces, SAFEGUARD had more limited aims. Emphasis was placed on the protection of the Minuteman sites and only light overall protection of the population would have been provided even when all sites had been completed.

In making these proposals the US defense authorities were anxious to avoid giving the impression - especially to the Soviet Union authorities - that they were seeking to alter the strategic balance. By proposing only limited protection for the major population centers - adequate perhaps to deal with a minor or accidental attack but totally inadequate to defeat a major attack - they hoped to make it clear that they were seeking only to protect their deterrent forces. Many experts at that time took the view that the development and deployment of ABM Systems would have a destabilizing effect on the relationship between the United States and Soviet Union. In August 1969 the U.S. Senate approved, by only one vote, the Phase I deployment of the system, thereby authorizing the commencement of construction work on two sites at Malmstrom AFB, Montana, and Grand Forks AFB, North Dakota.

So an ABM system for defense of the continental United States was ready for deployment. ARADCOM, over the years, carried the ABM fight for the Army. Since its commanding general was the senior air defense officer in the Army, he had considerable clout within the bureaucracy. An example was Lt. Gen. S. R. Mickelsen who, in 1955, urged DA to make the ABM weapon a "firm Army requirement" and assure its development at an optimum rate. His position was not abandoned by his five successors (to 1966). Subsequently, ARADCOM steadily increased the command's participation in ABM development. The quest continued despite periods of intra-service and interservice rivalry, national controversy and sheer frustration.

Although the command's inherent interest in the ABM spanned the distance from drawing board to deployment, this interest did not become a specific area of staff jurisdiction until the establishment on May 31, 1957, of the Plans and Requirements Section at ARADCOM headquarters. Enjoying G-staff status, the activity was redesignated Combat Developments Section before being integrated into the G-3 staff structure.

ARADCOM formed the NIKE-ZEUS Task Management Group in 1960, consisting of members from the command's Signal, Ordnance, Chemical and Engineer sections. The command's Director of Combat Developments also organized the NIKE ZEUS Test Unit USARADCOM at the Army Air Defense Center, Fort Bliss, Texas. Both the Task Management Group and the Test Unit continued operations well into the late 1960s.

DA assigned nine specific tasks for ARADCOM related to ABM. Six of the most critical tasks were to

- formulate and document doctrine,
- monitor research and development,
- provide guidance regarding user objectives and requirements,
- execute the tactical site selection program,
- formulate on-site training plans and
- prepare and coordinate logistic support plans.

Obviously, ARADCOM leaders were deeply involved in fielding the ABM system, not standing on the sidelines and waiting for some research and development organization to hand it to them. This would have made for a smooth transition and integration if an ABM system had been fielded.

Inactivations

The decade closed with ARADCOM showing signs of decline. Units had inactivated at the SAC bases and in several city defenses. ARADCOM's command historian summarized the reductions in these words:

In 1963, ARADCOM had reached its peak deployed strength of 134 NIKE HERCULES batteries and eight HAWK batteries on site in the defense of the population centers and SAC bomber bases in CONUS and Greenland. After withdrawal of the Greenland air defense in 1965 and the inactivation of SAC base defenses in 1966, the total of NIKE HERCULES batteries had dropped to 112. By the end of 1968, two more cuts had reduced even this total to eighty-seven, and a further reduction to eighty-two batteries for 1969. When the latter cut was completed, NIKE HERCULES would stand at only 61 per cent of the

1963-64 figure.

Just one year previously, the same author wrote a rationale for the cutbacks:

The conflict in the Republic of Vietnam continued, however indirectly, to exert a major influence upon ARADCOM throughout 1968. The mounting cost of operations in Southeast Asia and the associated threat of uncontrolled inflation in the United States created a demand for Federal - and especially military- economy which contributed to a partial dismantling of ARADCOM in this year and carried a potential for disaster in the longer term.

Summary

Words frequently used to describe the '60s are "change, confusion, disillusion." The '60s were no less for ARADCOM. ARADCOM changed through the constant buildup and transition to new, more modern systems. It reached its peak in firepower, leveled off, then started to decline. ARADCOM was confused over ABM, its hope for the future, being hotly contested and downgraded. It became disillusioned at having provided a deterrent for so many years, then being reduced even while the threat continued to expand its strategic nuclear forces to all-time highs.

Chapter One

Chapter Two

Chapter Three

Chapter Four



CHAPTER FOUR: Phasing Out

From 1970 to 1974, ARADCOM continued to diminish in size. Hope for the future of the command rested in the SAFEGUARD ABM system under construction at Grand Forks, ND, and plans for the next generation of SAMs, in this case SAM-D. But ARADCOM would not exist long enough to field either of these new systems.

Although the Soviets increased and modernized their strategic ballistic missiles, they experienced a leveling off, if not a slight downward trend, in numbers of strategic bomber aircraft. Bomber forces had been totally eclipsed by Soviet land-based and submarine-launched ballistic missiles.

Within the United States, the war in Vietnam still held center stage. Once the "Vietnamization Program" had been completed and the majority of U.S. forces had been pulled out, the nation began to reduce the size of the military. The force reduction would indirectly affect critical decisions impacting ARADCOM. Strategic Arms Limitations Talks and the ABM Treaty would also be factors.

ARADCOM fought a losing battle for its existence during the first four years of this decade. Once the decision was made to close the command, over much protest and counter-arguments, ARADCOM carried out this mission as professionally as it had the mission of defending the United States in the preceding 23 years.

The Threat

The early '70s saw a tenacious drive by the Soviet Union to continue deployment of its major strategic missile systems; produce an increasing number of nuclear-powered missile launching submarines; continue testing of a prototype variable-geometry, swept-wing intercontinental bomber; improve the re-entry vehicles of existing intercontinental ballistic missile systems; and retire fewer of its aging long-range bomber aircraft from the inventory than had been expected.

At the end of 1971 the Soviets had an estimated 1,424 ICBM launchers in service at ICBM complexes: 294 for the large SS-9 missile, 860 for the smaller SS-11, 61 for the solid propellant SS-13 and 209 for the older and more vulnerable SS-7 and SS-8 Systems. These five missiles were deployed at a total of 24 regular ICBM complexes.

An example of the Soviet increase in ballistic missiles was the 1970 deployment of 80 more of their largest ICBM, the SS-9, bringing the total number of these multiple warhead missiles to more than 300. The Soviets also added 200 smaller SS-11s (for a total of almost 1,000), all of them refitted for multiple warheads and penetration aids and/or decoys, and ten more solid propellant SS-13s were deployed the same year. The Soviet ICBM force consisted of five operational Systems and totaled about 1,500 operational launchers at the end of 1972. Some 90 percent were believed to be located in hardened silos.

The Soviet's LRA forces retired 15 of their Badger aircraft while adding five twin turbojet Blinders for a total strength of 910 aircraft: 85 Bisons, 110 Bears, 535 Badgers and 180 Blinders. LRA reflected a decrease of only 30 aircraft in 1971. The LRA had 195 heavy bombers and tankers based at five airfields in the Soviet Union. These aircraft - the Tu-95 Bear and the M-type Bison - were the only bombers with a primary mission of intercontinental attack.

Bear aircraft posed the most serious threat to North America because of the size of the force, air-to-surface missile configuration and the range of the aircraft. There were 110 of the four-engine turboprop aircraft, and they formed the largest element of the heavy bomber force. They could cover virtually any important target on two-way missions. About 50 of the 85 four-jet Bisons would require Arctic staging and in-flight refueling for extensive coverage of North America on two-way missions. The LRA also maintained 685 Tu-16 Badger and Tu-22 Blinder bombers based throughout the Soviet Union. These aircraft had a limited capability for intercontinental attack, although some could be used on one-way missions in an all-out nuclear assault against North America.

The number of Y-class (Yankee-class) nuclear-powered ballistic missile launching submarines more than doubled in 1970 with the addition of nine more. This meant that 272 SS-N-6 ballistic missiles were available along with 102 of the older 55-NAs and SS-N-5s.

Production of the 16-tube Yankee ballistic missile submarine continued in 1971. These submarines were being constructed at an average rate of nine per year. With the SS-N-6 missile, the Yankee submarines on-station off the east and west coasts of the United States could strike most targets in the country. In 1971 the Yankee inventory increased by eight units, bringing the total to 25 operational units. Another 15 were in various stages of construction, fitting out and sea trials.

The year 1971 saw the Fractional Orbital Bombardment System become operational after one crew-training mission.

This system was evidently designed to attack the United States via the South Polar route.

At the end of 1972, China's military forces still could not operate strategically against North America in any meaning-fill sense. By the mid-1970s, however, the Chinese could deploy a variety of ballistic missile systems, including a few ICBMs,

capable of reaching targets anywhere in North America. The first Chinese ICBM with significant capability against North American targets could reach operational capability as early as 1974, but a year later seemed more likely. Up to 30 first-generation ICBMs could be operational by mid-1976.

The Nation

Various mutually reinforcing influences combined in 1970 to form a climate of indifference and even hostility to requirements of the defense establishment. Although the cost of military operations in Southeast Asia was chiefly blamed for mounting taxes and an inflated economy, defense spending in general continued to be attacked by pressure groups clamoring for greater federal support of favored domestic programs and by representatives of the so-called "peace movement," who looked upon all military requirements with suspicion. The disillusion engendered by isolated but widely reported atrocities and corruption involving American military personnel in Asia and by congressional criticism of cost overruns in the development of weapon systems was a contributing influence. Also, the euphoria produced by the prospect of an agreement with the Soviet Union on arms limitation stood in the way of SAFEGUARD's development and deployment.

On the other hand, a slightly more favorable Senate attitude concerning SAFEGUARD deployment was evidently tied to the hope of success in arms limitation talks with the Soviet Union. Approval of a limited expansion of the system, it was argued, might be an effective inducement to negotiate. The generally recognized alternatives to success in these talks were expanded strategic offensive as well as defensive systems.

In 1971, public distaste for the war in Vietnam continued, and with it a mood of discontent and disillusion that weakened support of the military establishment and fostered a quasi-isolationism. This mood was reflected in, and possibly also fed by, the sporadic attacks of Sen. William Proxmire, D-Wis., and others on cost overruns in weapon-system development.

American participation in the ground war in Vietnam was winding down. On April 7, 1971, the President announced that the United States would withdraw 100,000 troops from Southeast Asia before December. "American involvement in this war," he said, "is coming to an end."

In this climate, and in a period of widespread concern over rising prices and wages, pressure to reduce military budgets was strong. At the same time, arms talks with the Soviet Union were continuing with general expectation of agreement. Under these circumstances, ARADCOM could hope for little more in the immediate future than to maintain its mid-1971 NIKE HERCULES strength with little prospect of an early expansion of SAFEGUARD deployment.

The presidential election occupied much attention during 1972. Despite the outcome (Nixon's 521 electoral votes to McGovern's 17), it became increasingly difficult to determine what the national opinion was on any given issue.

The headlines of the *New York Times*, December 31, 1972, edition: "Nixon orders a Halt in Bombing of North Above 20th Parallel," and "Peace Talks Will Resume Jan. 8," reflected the imminent end of the United States' involvement in Vietnam. The accompanying implications for "drawdown" resounded throughout the nation's military establishment. During 1972, ARADCOM succeeded in remaining relatively untouched by efforts to reduce the active Army. It attributed its success to the nation's realization of the importance of "keeping our guard up," and hoped that the traditional attitude toward streamlining and reducing the size of the military would not be repeated. The treaty limiting ABM systems signed by President Nixon and Secretary General Brezhnev on May 26, 1972, affected many ARADCOM plans. It meant that SAFEGUARD, which had gradually decreased from the deployment as first envisioned, would stabilize with the one site under construction in Grand Forks, ND, and an accompanying open option for a possible second site.

The Military

During the early 1970s, successive secretaries of defense, especially Melvin Laird, attempted to secure President Nixon's 1968 campaign pledge of "peace with honor." Thus he developed and strongly supported "Vietnamization," a program intended to expand, equip and train South Vietnam's forces and assign to them an ever-increasing combat role, at the same time steadily reducing the number of U.S. combat troops.

Laird also had a significant impact on the fate of ARADCOM. In 1973 a major change was made in air defense policy. He vocalized this change in philosophy when he stated that it was currently beyond the technological capability of the United States to meaningfully limit damage of urban areas by a well coordinated nuclear attack.

The beginning of the end started in March 1973, when the secretary of defense issued a series of planning and

programming guidance memorandums. For the next five months, these memorandums were discussed, debated and contested by JCS, the services, CONAD/NORAD and ARADCOM, but to no avail. In August the secretary of defense issued a program decision memorandum (PDM) that redefined the strategic air defense mission, eliminated the requirement for a defense against strategic bomber attacks, and concentrated on missions of warning of an impending bomber attack and airspace control. It directed a major reduction in air defense interceptors and the retirement of all existing CONUS Program I, strategic force air defense SAMs. The PDM specified that 35 of ARADCOM's 48 NIKE HERCULES batteries, less the 31st ADA Brigade in Florida, be phased out by the end of FY75, with the remaining 13 batteries inactivated by the end of

FY76. This decision was also contested, but fell on deaf ears.

ARADCOM

ARADCOM entered the 1970s with the same three-fold mission it had retained over the years. ARADCOM provided the Commander-in-Chief, North American Air Defense Command, with combat-ready air defense forces; support for SAFEGUARD, with deployment planning and advanced ballistic missile defense planning; and ADA units to the Commanding General, United States Continental Army Command, for employment in ground defense, civil disaster and other emergency missions.

Each year of the 1970s saw ARADCOM reduce the number of firing units and associated headquarters. Cuts that started in 1964 continued to the final ones in 1974.

A first cut of 22 fire units, taken in 1964, had removed the NIKE HERCULES defenses of SAC bomber bases and Thule Air Base in Greenland. This action had been justified by the belief that these bases were more susceptible to attack by ICBM than to bombing attack. Subsequent cuts, however, had been undertaken almost purely as economical measures for which system analysts of the Office of the Secretary of Defense (OSD) had provided a rationale.

The major premises of that rationale were an assumption that the threat of Soviet bomber attack had decreased sharply, a conviction that the current air defense force was costly and ineffective, a belief that air defense of urban areas would be eliminated by initial ICBM attack, and faith in the concept of perimeter defense by USAF airborne warning and control systems (AWACS) and F-106 aircraft. To these there had been added in the FY70 Draft Presidential Memorandum the contention that any NIKE HERCULES units that might survive an ICBM attack would be ineffective in countering a follow-on, low-altitude bombing attack in which electronic countermeasures (ECM) were employed.

ARADCOM held that most factual evidence supported contrary views. In spite of intelligence projections of

declining Soviet bomber strength, the size of the threat had remained constant; ARADCOM forces, in fact, offered protection to a significant portion of the population and economic base at relatively small cost; destruction of a significant number of NIKE HERCULES units would be possible only if sufficient ICBMs were available to target each unit; a perimeter defense, technically premature at present (1973), would inevitably be porous and require to be backed by defense in depth; and test results showed that, far from being ineffective, NIKE HERCULES units provided a highly effective defense in the face of fairly heavy ECM and limited early warning. More-over, to eliminate the air defense of cities because of their vulnerability to missile attack would be to offer an attacker the option of employing bombers against little or no resistance.

These and other arguments notwithstanding, the reality of the 1970s was that ARADCOM would be reduced to zero fire units by 1974. The first cuts were the defenses in Cincinnati-Dayton and Niagara Falls. The following year, 1971, the Minneapolis-St. Paul, Cleveland and Milwaukee defenses were eliminated, along with one of the three remaining regions. The next reduction took place in 1973, with several brigade, group and battalion headquarters either being consolidated or eliminated.

The 1973 PDM sounded the death knell for ARADCOM. It called for the phase-out of 35 NIKE batteries in FY75 and the remaining 13 by the end of FY76. Despite further objections voiced by JCS, CINCNORAD, DA and ARADCOM, a subsequent deputy secretary of defense program budget decision (PBD) provided for accelerated inactivation of the firing batteries.

ARADCOM's operational forces were reduced by 17 firing batteries and four command and control centers on March 1, 1974, followed by another reduction of 17 batteries and two command centers on April 1. On May 1, an additional 14 batteries assumed a released status, along with two corresponding command and control centers. All 1st and 6th Region units were relieved of their CONUS air defense mission by respective NORAD/CONAD region commanders to prepare for inactivation. As of May 1, ARADCOM's operational air defense forces consisted of four NIKE HERCULES batteries and four HAWK batteries in the Miami-Homestead Defense, four HAWK batteries in the Key West Defense, and a corresponding command and control center in each defended area.

Another part of this equation was the National Guard forces supporting ARADCOM. State adjutant generals were informed that no replacement of inactivated (NIKE) units was planned in the revised force structure. States were authorized to reassign ADA technicians, to the fullest extent possible, to positions within their retained force structures. Provisions were made to relocate ADA technicians in existing vacancies of other states. Personnel assistance teams were provided by National Guard Bureau (NGB) to aid in placement of technicians. All employee entitlements were assured, to include wage protection, severance pay and relocation allowances.

The ARADCOM commander sought DA's assistance for approximately 300 technicians who could not be placed in other units. He also recommended that extraordinary measures be taken for the retention and promotion of ARNG officers and warrant officers.

Although reductions in force and the eventual inactivation of the command dominated the decade, other relevant programs

and events continued. ARADCOM continued to plan for SAM-D as a follow-on to NIKE HERCULES. Although DA approved a programmed deployment of 48 SAM-D fire units within the continental United States, the secretary of defense and the assistant secretary of the army for research and development deferred the deployment.

Another advance system, the ANITSQ-73 Missile Minder command and control system, underwent testing at the Miami-Homestead Defense. The Missile Minder was under development to replace the Missile Monitor for the field Army, but was not destined to be integrated into ARADCOM.

The last vestige of an operational capability by ARADCOM was relinquished upon the transfer of the 31st ADA Brigade to United States Army Forces Command (FORSCOM). This occurred on October 1, 1974, as directed and planned by the Army chief of staff. Under this concept, operational command of the remaining CONUS ADA forces was retained in CONAD.

SAFEGUARD

The parallel mission responsibility of ARADCOM to develop and deploy a ballistic missile defense system for CONUS was continued until the functions were assumed by the Ballistic Missile Defense Program Manager on September 3, 1974.

This September 3 handoff from ARADCOM to the program manager preceded, by 13 months, the date that the SAFEGUARD complex in North Dakota became operational. This complex, called the Mickelsen Complex after ARADCOM's third commanding general, Lt. Gen. Stanley R. Mickelsen, was located 100 miles northwest of Grand Forks. Its reason for being was to defend 150 Minuteman missiles located nearby and to provide a "light" defense of the upper-Midwest of the continent against ballistic missile attack.

Donald Baucom gives a succinct description of the Mickelsen complex in his book, *The Origins of SDI*:

In a number of ways, the Mickelsen facility was a technological marvel. The 80-foot-tall truncated pyramid that housed the antennas for the MSR dominated the flat landscape around the town of Nekoma. The structure's four-foot-thick concrete walls were sloped at a 35-degree angle to provide hardening against the effects of nuclear blast. Each sloping surface of the pyramid held a radar antenna that was 13 feet in diameter and contained five thousand phased-array elements.

The four faces of the MSR allowed it to search for targets coming from all directions, and it could acquire these targets at a range of 300 miles. The MSR worked in conjunction with a PAR near Cavalier, North Dakota, 25 miles northeast of the missile Site. This was also a phased-array radar, but it was designed to search in only one direction - toward the north. In the event of a Soviet attack, the PAR would detect incoming missiles at a range of 1 800 miles, about the time the warheads were passing over the North Pole. Detection at this range would allow only six minutes to plan the battle against the approaching reentry vehicles. Computers associated with the PAR would determine the trajectory of incoming missiles and pass the information to the MSR for control of the defensive missiles that would attack the warheads.

Two types of missiles were employed in the SAFEGUARD system. The high-altitude SPARTAN missile was built by McDonnell Douglas. It was a three-stage, solid-propellant rocket armed with a nuclear warhead that killed warheads by blast and X-rays that were lethal to warheads several miles away. SPARTAN was 55 feet long. The second missile, SPRINT, was a marvel of aeronautics and space technology. Built by Martin Marietta, it was designed to operate at hypersonic speeds in the earth's atmosphere; at its top speed, the missile's skin became hotter than the interior of its rocket motor and glowed incandescently. If one somehow could have trained an acetylene torch on the nose of the missile at this speed, the hot gases of the torch would have cooled the nose. The electronic components of the SPRINT were designed to withstand accelerations of 100 times gravity. The missile was 27 feet long, consisted of two stages, and used solid fuel. Like SPARTAN, SPRINT carried a nuclear warhead.

Together these missiles provided a "layered" defense. SPARTAN was designed to attack the incoming "threat cloud" of warheads, boosters and decoys while it was still above the atmosphere. SPRINT would then attack surviving warheads after they had penetrated the atmosphere where the resistance and friction of the air would separate the warheads from decoys and booster debris.

Summary

Like all good soldiers, ARADCOM's commanders and staffs fought for what they thought was needed-- a credible defense of the United States from attack by air. But once the decision was made to inactivate the command, they followed orders and accomplished the mission ahead of schedule. The entire command, less the three Florida battalions and the SAFEGUARD complex, stood down.

Epilogue

The three remaining Army air defense battalions deployed for the defense of CONUS would last for several more years, to the end of the 1970s, before inactivation. But the Mickelsen SAFEGUARD complex operations would be measured in months, not years. As the *Origins of SDI* reads:

SAFEGUARD's "technical sweetness" was overshadowed by its limitations. With only one hundred missiles, the system could provide only limited protection to the ICBMs near Grand Forks and supply some measure of protection to the central United States against an accidental launch or a light ICBM attack. Moreover, SAFEGUARD was not the optimum system for the point defense of hard targets. It started out as the SENTINEL project, which was supposed to provide nationwide protection against a light ICBM attack. When President Nixon shifted the emphasis of the program to defending ICBM fields, the United States wound up using an area defense system for a point defense mission. The area defense concept involved the use of the large, powerful long-range radar systems that were hallmarks of the Mickelsen complex. In addition to being subject to blackout caused by the detonation of nuclear warheads, these radar systems could be attacked directly. Once they were destroyed, the SPAR-TAN and SPRINT missiles were electronically blind and therefore useless.

In the fall of 1975, the same limitations that hampered SAFEGUARD led to the inactivation of the Mickelsen SAFEGUARD complex. On Oct. 2, 1975, one day after SAFEGUARD became operational, the House voted to inactivate the system. DoD studies made available to the House Committee on Appropriations in September had shown that Soviet missiles with multiple warheads would be able to overwhelm the system.

The vulnerability of SAFEGUARD's radar systems was also a factor in the committee's decision. DoD itself drove the final nail in SAFEGUARD's coffin. During proceedings of the House, it was discovered that DoD had been planning for two years to inactivate the North Dakota site on July 1, 1976.

The House voted against SAFEGUARD, and the Senate voted several times on different proposals. Finally, in November 1975, the Senate passed a bill that would allow operation and testing of the site's perimeter acquisition radar but would close down the remainder of SAFEGUARD.

In February 1976, the Army began carrying out the directions of Congress. Specifically, site technicians stopped the radiation of power from the missile site radar and began removing warheads and missiles from their launching cells. Furthermore, the Army started transferring personnel to other locations and began to dispose of excess property.

The \$5 billion complex, operational for only five months, was now in caretaker status.

Conclusions

Some relevant conclusions can be drawn from the 24 years of ARADCOM experience, and several years that preceded it. In keeping with the overall organization of this study, the conclusions fall under the major headings of the threat, nation, military and ARADCOM.

The Threat

1. Soviet and Chinese offensive capabilities, either real, potential or imaginary, drove deployment of U.S. defensive systems.

Several examples of real threats were Soviet bombers with intercontinental range, especially the Tu-4 Bull in 1950 and the Bisons, Badgers and Bears of the mid-1950s. The deployment of a massive air defense network, CONAD, and later, NORAD, was the U.S. response.

Potential threats took the form of anticipated scientific and technological breakthroughs by the enemy. The United States saw that if it possessed a military capability that the Soviets did not, it would only be a matter of time until the Soviets developed it. The United States also envisioned the Soviets developing ballistic missiles. The atomic bomb, jet-powered bombers and ballistic missiles were all within the potential capability of the Soviets to produce. Left to speculation was the probable date these Systems would emerge. This was usually underestimated.

Military analysts often exaggerated the size and capability of the threat. The United States normally tended to overestimate Soviet capabilities, once the technology was openly displayed, and imagined the Soviets possessed capabilities they did not have. The "Bomber Gap" and "Missile Gap" are prime examples.

2. The Soviet Union strategically outmaneuvered the United States by de-emphasizing strategic bombers and concentrating on ballistic missiles. In the late 1950s, knowing that it would take many years and billions of rubles to match America's strategic bomber might, the Soviets placed their emphasis on ballistic missiles instead.

3. Massive numbers of strategic nuclear weapons ultimately countered the Army's role in continental air defense.

The Nation

4. The United States had a tendency to underestimate the Soviets' potential for advancement. It would be shocked over a Soviet scientific breakthrough, then immediately overreact and overestimate the Soviet capability. The United States

underestimated the dates when the Soviets would be able to detonate a nuclear device, build a jet bomber and launch a ballistic missile. When these events occurred, American confidence was shaken. The 1949 atomic detonation, the 1955 Bison bomber show and the 1957 Sputnik orbit added to a false perception that the United States was losing the technology battle.

5. The armed forces need to understand the importance of Congress as representatives of the people in supporting programs. A combination of events in the early 1950s sold the American people on the idea of defending their country from attack by air. The Korean War, American scientists publicizing the need for air defense and a national strategy that discussed nuclear and conventional strategy were key factors that led to a decision to deploy a defensive network.

A reversal in public support took place in the following decades because of the fear generated by the manufacture of thousands of nuclear weapons, the Vietnam War, antiwar and antimilitary movements, and the resultant national debate over the deployment of ABMs.

Congressional involvement in every facet of military matters, and the political consequences thereof, left many in ARADCOM with the firm belief that "politics were pervasive from the start to finish of ARADCOM.

The Military

6. Cooperation among the different services is essential. When they cooperated, the armed forces accomplished many feats, a most noteworthy one being the vast air defense network under CONAD/NORAD.

But when they fought and became recalcitrant, the opposite was true. The inability to resolve Army air defense weapons control issues is an example.

7. The military services must share technology and plans early-on to avoid incompatibility. The Air Force's SAGE inability to directly interface with the Army's Missile Master is an example of not sharing.

ARADCOM

8. Technical vision is key to eventual deployment. Project NIKE resulted in NIKE AJAX eight years later, and Mickelsen's NIKE ZEUS advocacy resulted in SAFEGUARD 18 years later. ARADCOM also contributed to the development and fielding of improved and more effective air defense equipment and techniques. By continuing to strive for excellence, the electronic and ordnance industries were continually kept on the "cutting edge" of technology. This reflected itself into other equipments, techniques and endeavors and materially benefited our nation. We must also give APADCOM credit for educating a host of officers and enlisted men in not only military matters, but also in technical capabilities and techniques that benefited - and still benefit - the nation in numerous ways.

9. Planning and construction are essential for deployment. When soldiers are called upon to train on the positions they would fight from, and occupy those positions day and night, more than just open fields are required.

Fixed sites require permanent facilities that are of reasonably good quality.

10. The old saying "they also serve, who only watch and wait," appropriately applied to the thousands of dedicated soldiers of APADCOM. They worked long hours and often fought boredom, which was interspersed with times of great stress. They suffered long separations from family and home, even though they worked only a few miles away.

Acknowledgments

The primary reason for this work was my interest in reading about the Army Air Defense Command, or ARADCOM. Having served as an Army officer in the air defense field for 21 years, I had often heard of the command, but could find little written about it. After searching for sources of information on ARADCOM and finding only a slender volume that covered the period from 1950 to 1955, I decided to take on the task of writing a single volume on the command that would cover its entire period of duty, 1950 to 1974.

A secondary reason for this work was to add to the history of Air Defense Artillery. Walking the battle-fields around Remagen with my mentor and friend, Colonel E. Paul Semmens, and reading *The Hammer of Hell*, his history of World War II-era air defenders, inspired me to also dedicate some time for the ADA branch's history.

The opportunity to do this work was provided by the Army War College Fellowship Program. I spent 10 months in residence at the Ohio State University's Mershon Center to research, study and write *Vigilant and Invincible*.

I found the research and writing to be a particularly worthwhile endeavor. I learned a lot about my branch:

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Ironically, the end of the Cold War and the rapid proliferation of ballistic and cruise missiles has given the story of ARADCOM renewed relevancy. Congress has recently directed DoD to field a national missile defense against limited strikes. This mission, thanks to ARADCOM's pioneering work, presently is assigned to the Army and Air Defense Artillery. We will resurrect the nation's defense against weapons of mass destruction on building blocks left us by ARADCOM's "Vigilant and Invincible" soldiers.

COL. STEPHEN P. MOELLER

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Chapter Four

